Piggott & Whitfield
For
T Mobile, Beckton

Uninterruptible Power Supply System Installation

Operations & Maintenance Manual

Produced by:

Emerson Network Power
28/05/2010

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OPERATIONS AND MAINTENANCE MANUAL

Produced By: Emerson Network Power

UPS System Installation

SECTION 2

SCOPE OF WORKS

Introduction

This section of the manual provides a brief outline of the scope of work carried out by Emerson Network Power for Piggott & Whitfield as part of this contract.

The works were carried out after successful contract award for the UPS system supply and installation.

Works description

System Description

The UPS system consists of 2 x 400kVA HipulseE UPS configured for stand alone operation with LBS control (load bus synchronisation). Each UPS module will be supported by a VRLA battery consisting of 3 X 34 ESL150-12 WETAC batteries supplied on cladded stands and designed to support a load of 320DCKW for a period of 7mins.

UPS System requirements

The UPS and all associated equipment and components shall be manufactured in accordance with all applicable standards:
- EN 50091-1-1
- EN 50091-2
- ENV 50091-3

All UPS equipment shall be CE marked in accordance with EEC directives 73/23 “low voltage” and 89/336 “electromagnetic compatibility.”
The Quality System for the engineering and manufacturing facility is certificated to conform to Quality System Standard ISO 9001.

UPS System Description

2 x HipulseE 400kVA UPS modules.

Each UPS module to include:-

2 x Liebert **HiPulse E, 400KVA** Uninterruptible Power Supply Systems operating in Parallel - Redundant and supplied with the following features:

Input: 400 Volts, 3 Phase, 4 Wire, 50Hz
Output: 400 Volts, 3 Phase, 4 Wire, 50Hz
Rating: 400KVA/320KW per Module at **0.9pf Leading to 0.9pf Lagging**.

12 Pulse Rectifiers and additional integral **Harmonic Filters** thus exceeding the limits for Harmonics as detailed within the G5/4 guidance document.

Castell Key Interlocking for System Maintenance Bypass operation.

Battery Circuit Breakers.

Otherwise, as described in the User Manual.

Battery System Description

Per UPS module:-

Battery system, each comprising 3 x strings of 34 ESL 150-12 WETAC cells, each sized to support a load of 400 kVA / 320 kW for a period of 7 minutes.
Cladded battery stand dimensions,

UPS 1

2 Off Stands - L = 1730mm D = 1175mm H = 2450mm each

UPS 2

1 Off Stand - L = 3180mm D = 1175mm H = 2450mm each

Installation

1. Delivery and positioning of all equipment to site
2. Battery build and DC cable

Note: AC Cabling by others

Testing and Commissioning
Following routine commissioning / Level C module testing was performed on site, results are contained within this manual.

OPERATIONS AND MAINTENANCE MANUAL

Produced By: Emerson Network Power

SECTION 3

USER MANUAL

Contents

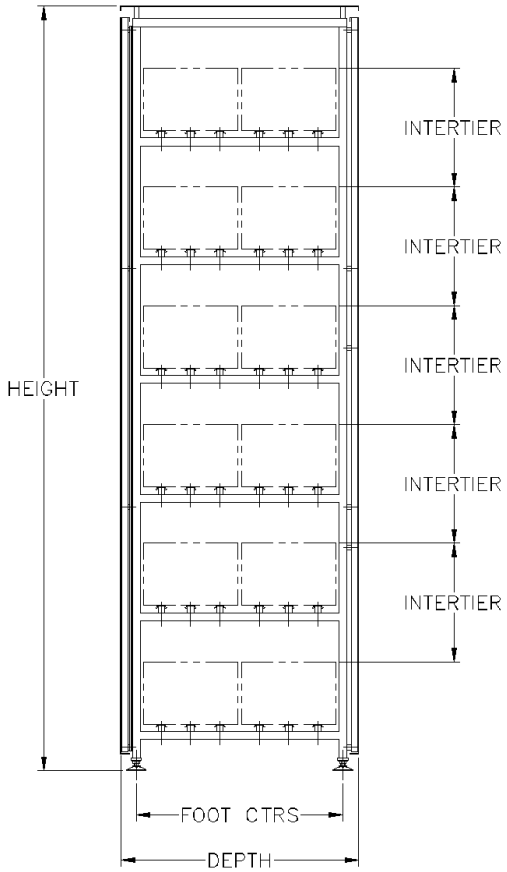
HipulseE 400kVA UPS User Manual

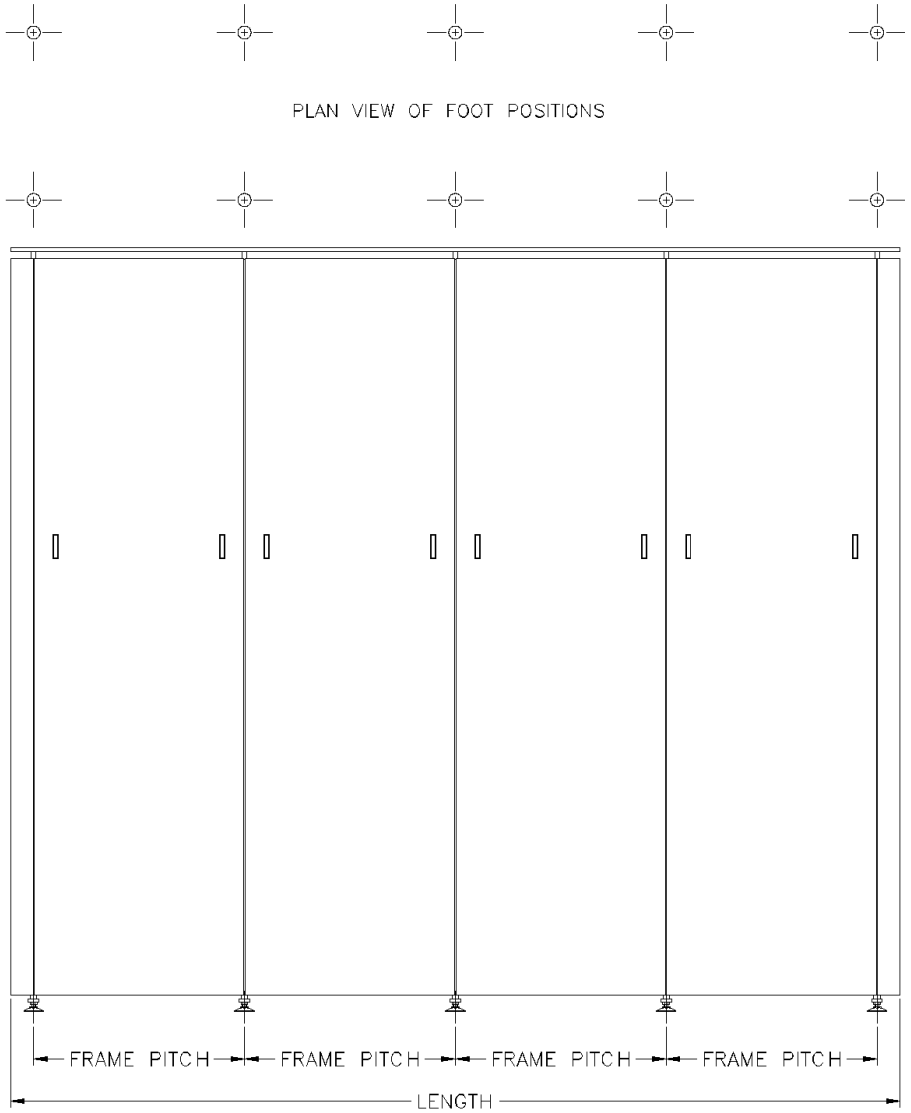
Full product & operation details for the HipulseE 400kVA UPS

Battery Systems

Battery consisting of 3 x 34 ESL 150-12 WETAC batteries supplied in cladded stands designed to support a load of 320DCKW for a period of 7mins

6 Tier 2 Row Cladded Stand To Accommodate 102 x ESL150-12





Stand Length = 1730mm

Stand Depth = 1175mm

Stand Height = 2450mm

Intertier = 375mm

Frame Pitch = 390mm

Foot Ctrs = 1055mm

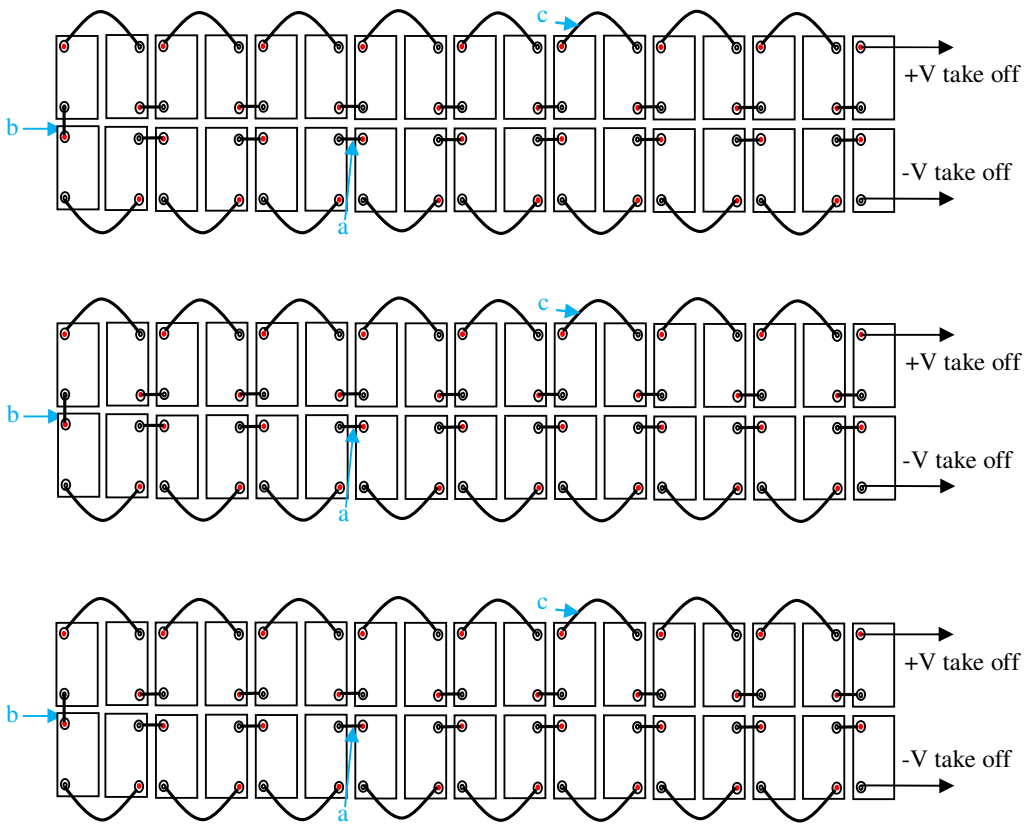
Foot Diameter = 75mm

Max. Foot Load = 648Kg

Surface Load = 23.720KN/m²

WETAC UK LTD
OFFICE 17
BOLTON BUSINESS CENTRE
44-46 LOWER BRIDGEMAN ST
BOLTON BL2 1DG

Layout Drawing for 3 x 34 ESL 150-12 on 6T2R Cladded Stand Site - Beckton ASC – Emerson Network Power (Half stand population).



Order for Emerson Network Power.

Sales o/n SO 787 (ref. 14040109470).

Supply

ESL 150-12
102 off

ACC CONN ESL55
48 off
(a) length = 75 mm

ACC CONN ESL134
3 off
(b)length = 100 mm

ACC IC CON LARGE
102 off

ACC C50356
48 off
(c) length = 350 mm

ACC IC GFL
96 off

ACC IC HAG 157
6 off
(Take off covers)

N.B. Take off covers are included, Take off cables are NOT included.

ACC ST 1-36
3 off

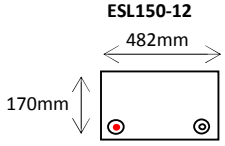
ACC ST +/-
3 off

Drawing
1 off

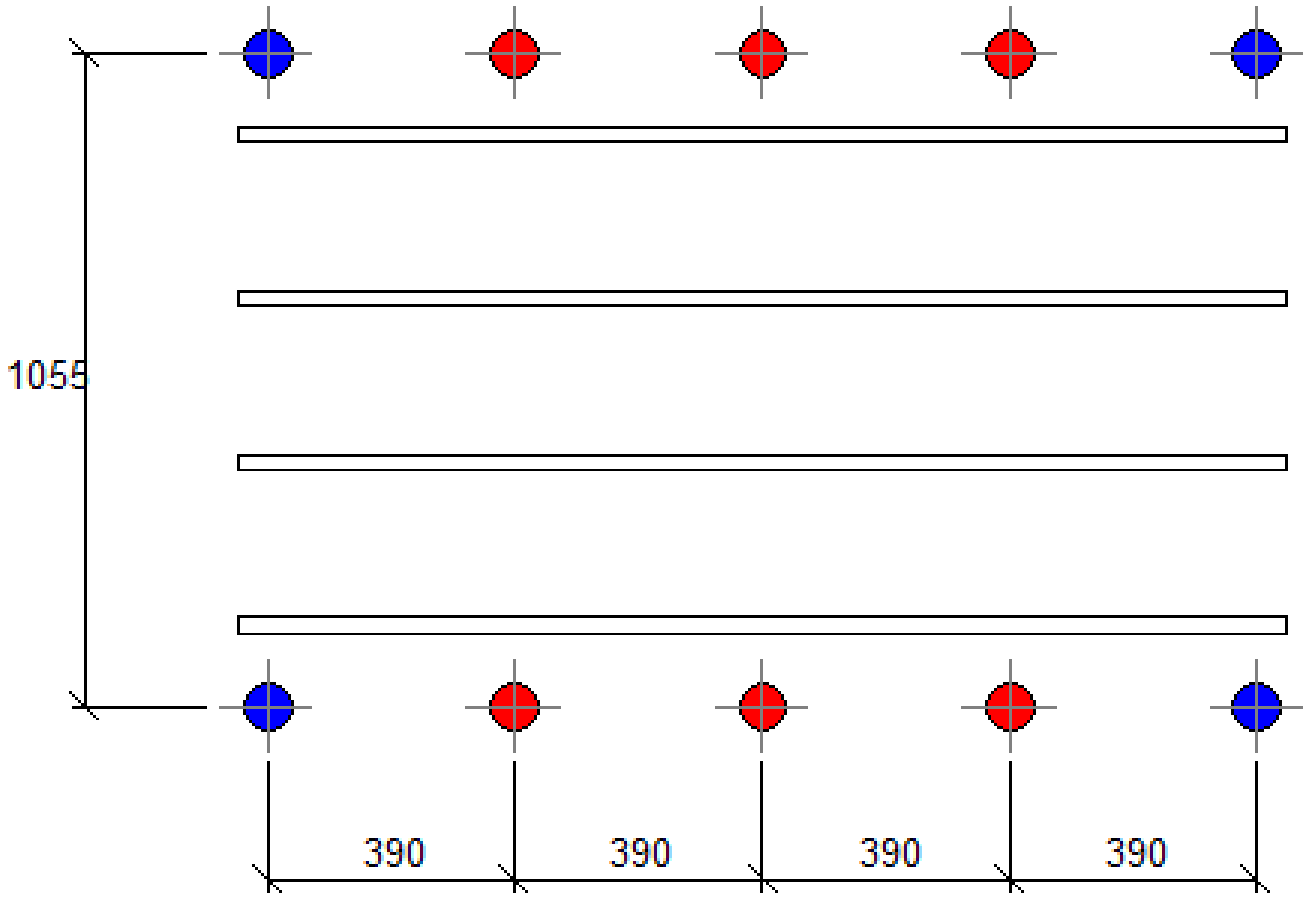
ACC INSTR. MAN
1 off

N.B. – The blocks and connectors are to populate the lower three rows of the stand. The blocks & accessories to populate the upper three rows are to be supplied separately.

Stand Specifications;
L x D x H = 3180 mm x 1175 mm x 2450 mm
Laden Weight = 9691 Kg
N.B. Inter tier height = 375 mm



Foot Layout Of 6 Tier 2 Row Cladded Stand To Accommodate 102 x ESL150-12

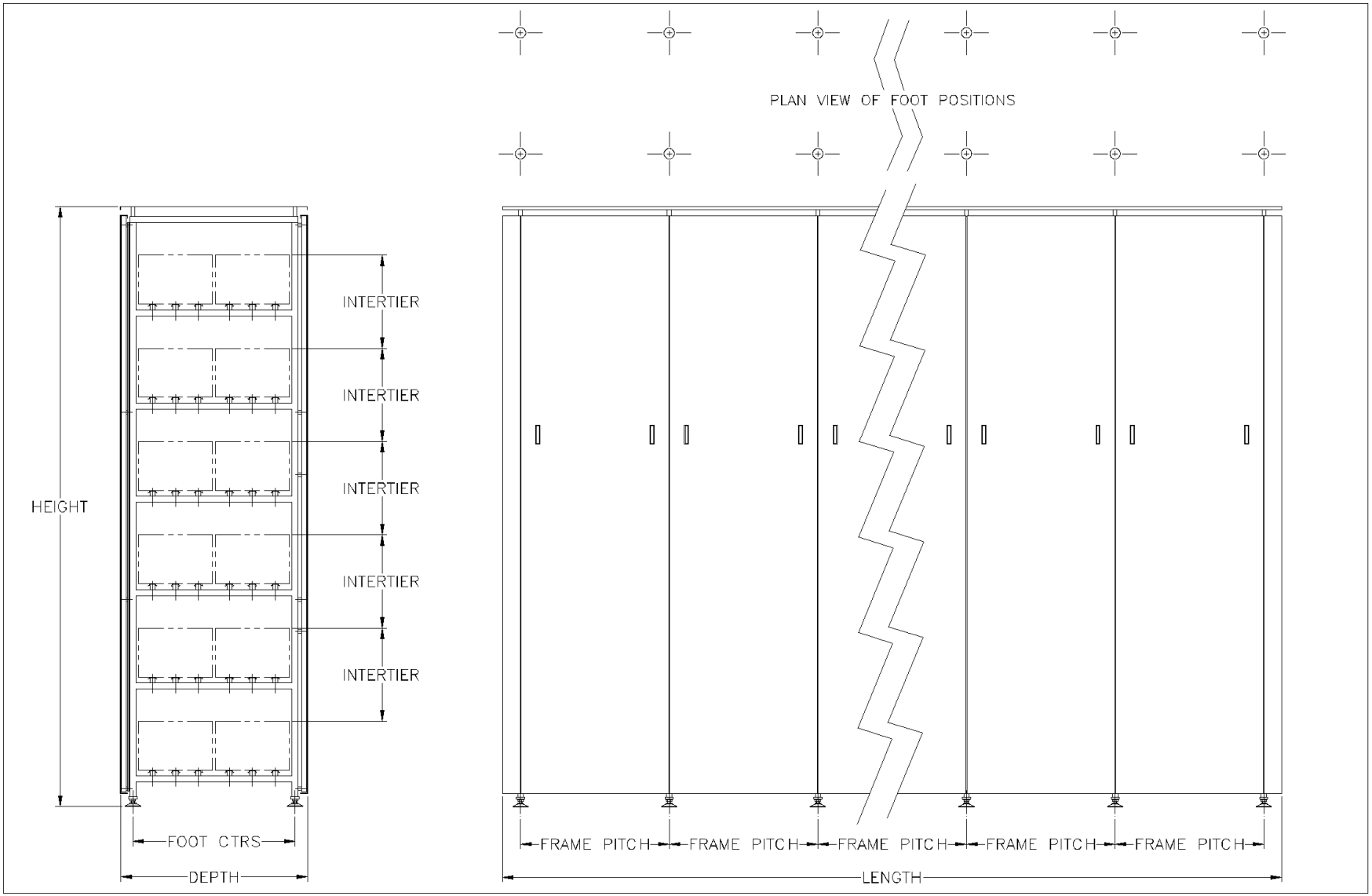


648Kg

324Kg

Foot Dia. = 75

6 Tier 2 Row Cladded Stand To Accommodate 204 x ESL150-12



Stand Length = 3180mm

Stand Depth = 1175mm

Stand Height = 2450mm

Intertier = 375mm

Frame Pitch = 430mm

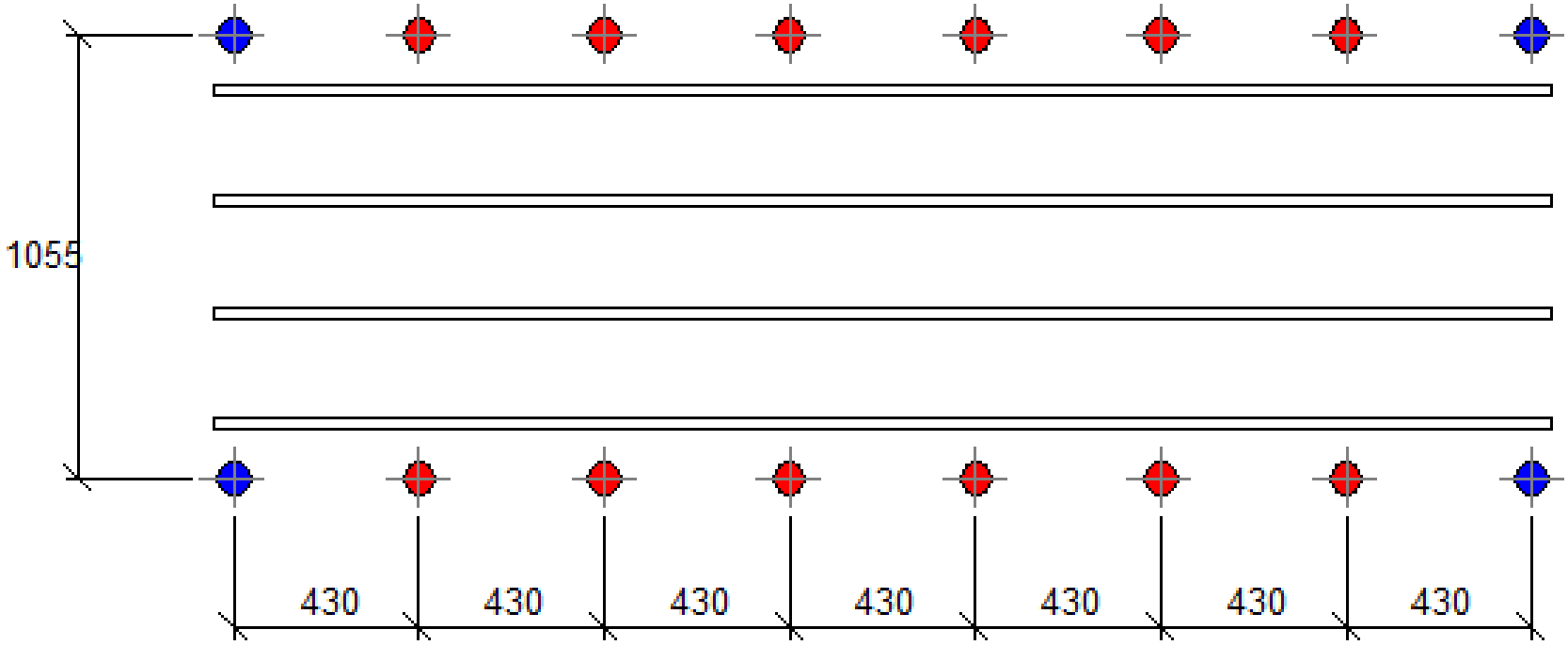
Foot Ctrs = 1055mm

Foot Diameter = 75mm

Max. Foot Load = 693Kg

Surface Load = 25.443KN/m²

Foot Layout Of 6 Tier 2 Row Cladded Stand To Accommodate 204 x ESL150-12



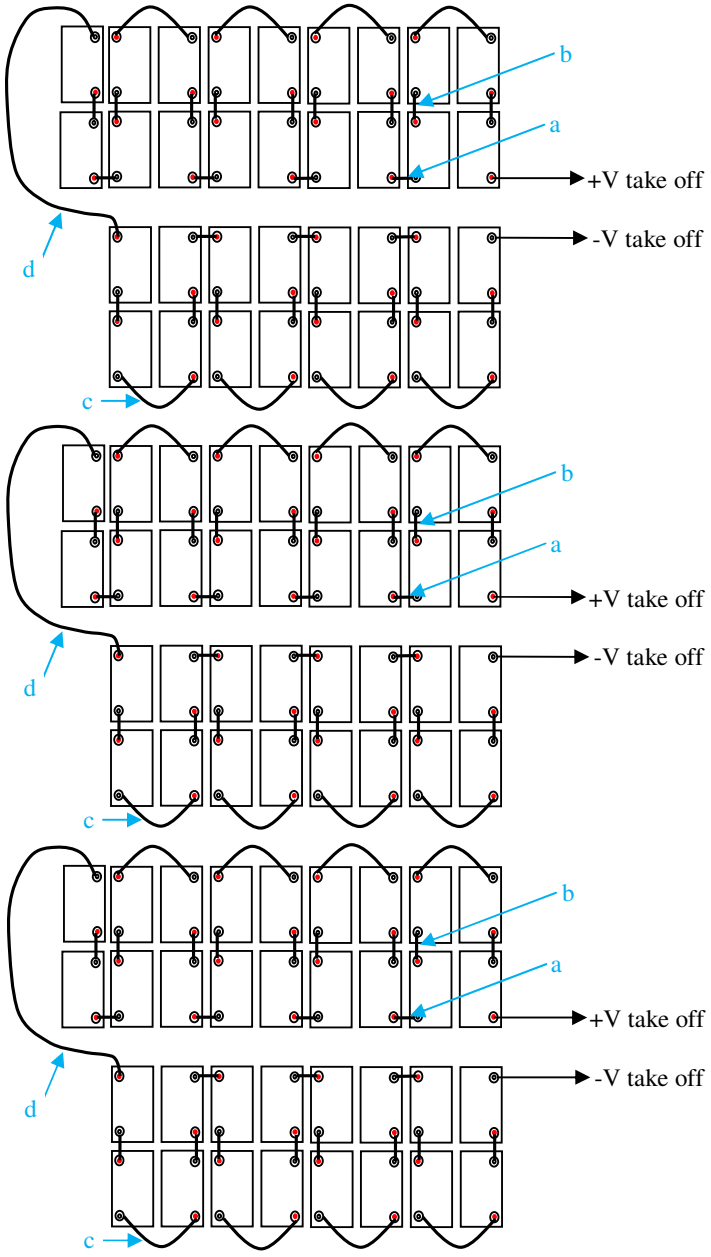
693Kg

346.5Kg

Foot Dia. = 75

WETAC UK LTD
OFFICE 17
BOLTON BUSINESS CENTRE
44-46 LOWER BRIDGEMAN ST
BOLTON BL2 1DG

Layout Drawing for 3 x 34 ESL 150-12 on 2 x 6T2R Cladded Stand - Site - Beckton ASC – Emerson Network Power (N.B. Second stand being supplied with this layout to be poplulated at a future date).



Order for Emerson Network Power.

Sales o/n SO 789 (ref. 14040109470).

Supply

ESL 150-12
102 off

ACC CONN ESL55
21 off
(a) length = 75 mm

ACC CONN ESL134
51 off
(b)length = 100 mm

ACC IC CON LARGE
144 off

ACC C50356
24 off
(c) length = 350 mm

ACC C501006
3 off
(c) length = 350 mm

ACC IC GFL
54 off

ACC IC HAG 157
6 off
(Take off covers)

N.B. Take off covers are included, Take off cables are NOT included.

ACC ST 1-36
3 off

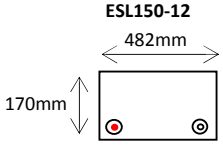
ACC ST +/-
3 off

Drawing
1 off

ACC INSTR. MAN
1 off

N.B. – The blocks and connectors are to populate #1 stand only.
The blocks & accessories to populate the #2 stand to be supplied separately.

Cladded Stand Specifications (N.B. total of 2 stands to be supplied with initial order) ;
L x D x H = 1730 mm x 1175 mm x 2450 mm
Laden Weight = 4915 Kg
N.B. Inter tier height = 375 mm



D_ELS150-12_3x34_6t2r_Emerson_BecktonASC_RAC100108

Liebert®

Power Quality Solutions

Liebert Hipulse E

Hi-Availability UPS
Uninterruptible Power Supply

300 and 400 kVA - 400V 50/60 Hz

EN

Installation Manual

SINGLE UNIT AND '1+N' (EXPANDABLE)

EMERSON™
Network Power

Dear **Customer**,

Please allow us to congratulate you on choosing a Liebert manufactured Uninterruptible Power Supply (UPS) system.

If this is your first Liebert UPS, we cordially welcome you to a lifetime relationship of post-sales support designed to keep your Liebert UPS and your systems permanently at their peak performance.
If you already own and use a Liebert UPS, then we are doubly honoured by your decision to continue this valued relationship.

It is our constant endeavour to partner you to ensure the growth & success of your business;
our philosophy is reflected in our mission statement "**Keeping Business in Business**".
Please give us your valued feedback to help us realise our mission.

EMERSON NETWORK POWER

This manual contains information concerning the installation of the Liebert Hipulse E
Single Module (Expandable) Uninterruptible Power System (UPS).

All relevant parts of the manual should be read **prior** to commencing installation.

The UPS must be commissioned and serviced by an engineer approved by the manufacturer (or his agent).

Failure to do could result in personnel safety risk, equipment malfunction and invalidation of warranty.

The Liebert Hipulse E UPS has been designed for Commercial/Industrial use only, and is not recommended for use in any life support applications.

Warning: This is a product for restricted sales distribution to informed partners.
Installation restrictions or additional measures may be needed to prevent disturbance.
(See EN 50091-2)

When Class A option is fitted, this is a Class A UPS (for Unrestricted sales distribution).
Anyway in a domestic environment this product may be cause radio interference in which case, the user may be required to take additional measures.
(See EN 50091-2)

If you encounter any problems with the procedures contained in this manual
you should seek immediate assistance from the Liebert Sales Office
from whom the equipment was purchased.
Alternatively, contact the Liebert's Customer Service & Support department
at the address shown below:

EMERSON NETWORK POWER S.r.l. (HQ)
Customer Service and Support Department
Via Leonardo da Vinci 16/18
35028 - Piove di Sacco (PD)
Italy

Help Desk Telephone +39 049 9719233
Fax +39 049 9719053

mailto:serviceUPS.LiebertEMEA@emerson.com

EMERSON NETWORK POWER Ltd - United Kingdom
Customer Service and Support Department
Globe Park
Marlow
Buckinghamshire SL71YG
United Kingdom

Telephone +44 1628 40 32 00
Fax +44 1628 40 32 03

Please visit our web site: http://www.eu.emersonnetworkpower.com

While every precaution has been taken to ensure accuracy and completeness in this manual, Liebert Corporation assumes no responsibility and disclaims all liability for damages resulting from use of this information or for any errors or omissions.

Liebert Corporation pursues a policy of continual product development and reserves the right to change the equipment design without notice.

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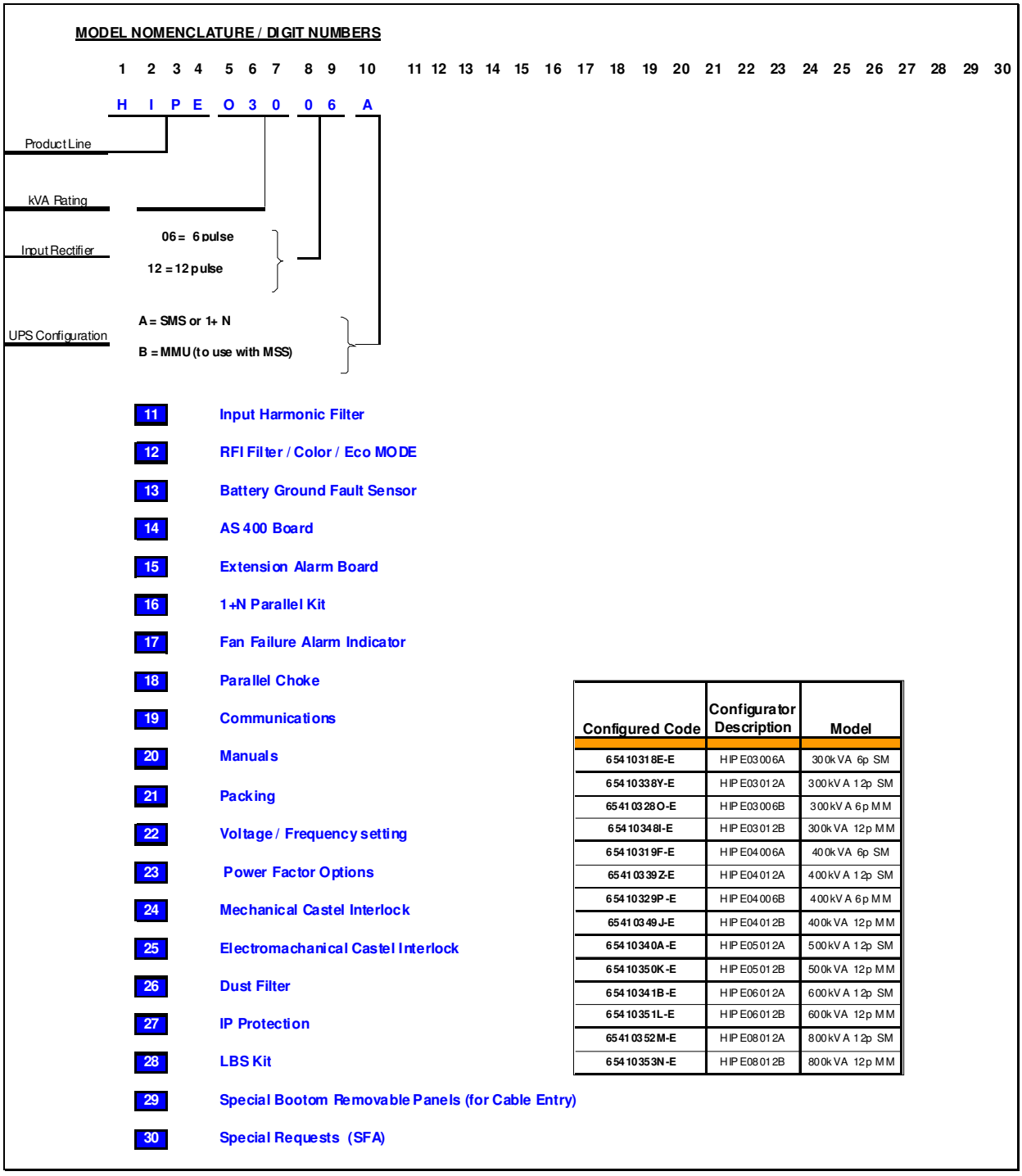
Model number nomenclature


MODEL NOMENCLATURE / DIGIT NUMBERS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
H I P E O 3 0 0 6 A
Product Line
kVA Rating
Input Rectifier
06 = 6 pulse
12 = 12 pulse
UPS Configuration
A = SMS or 1+ N
B = MMU (to use with MSS)
11 Input Harmonic Filter
12 RFI Filter / Color / Eco MODE
13 Battery Ground Fault Sensor
14 AS 400 Board
15 Extension Alarm Board
16 1+N Parallel Kit
17 Fan Failure Alarm Indicator
18 Parallel Choke
19 Communications
20 Manuals
21 Packing
22 Voltage / Frequency setting
23 Power Factor Options
24 Mechanical Castel Interlock
25 Electromachanical Castel Interlock
26 Dust Filter
27 IP Protection
28 LBS Kit
29 Special Bootom Removable Panels (for Cable Entry)
30 Special Requests (SFA)

Configured Code	Configurator Description	Model
6541031 8E-E	HIPE03006A	300kVA 6p SM
6541033 8Y-E	HIPE03012A	300kVA 12p SM
6541032 8O-E	HIPE03006B	300kVA 6p MM
6541034 8I-E	HIPE03012B	300kVA 12p MM
6541031 9F-E	HIPE04006A	400kVA 6p SM
6541033 9Z-E	HIPE04012A	400kVA 12p SM
6541032 9P-E	HIPE04006B	400kVA 6p MM
6541034 9J-E	HIPE04012B	400kVA 12p MM
6541034 0A-E	HIPE05012A	500kVA 12p SM
6541035 0K-E	HIPE05012B	500kVA 12p MM
6541034 1B-E	HIPE06012A	600kVA 12p SM
6541035 1L-E	HIPE06012B	600kVA 12p MM
6541035 2M-E	HIPE08012A	800kVA 12p SM
6541035 3N-E	HIPE08012B	800kVA 12p MM

Safety Precautions

CONFORMITY AND STANDARDS

This equipment complies with the following requirements:
Normative references: Uninterruptible Power System (UPS).
** IEC 62040-1-1 (2002) — 'General and safety requirements for use in operator access area';*
** EN 50091-2 (1995) — 'EMC requirements';*
** IEC 62040-3 (2001) — 'Performance requirements and test methods';*
** EN 60950 (2001) — 'Information technology equipment;*
** EN 60529 (1989) — 'Degrees of Protection provided by enclosures (IP Code)'*
and published technical standards. For more details, see Chapter 5 'Conformity and standards'.
Continued compliance requires installation in accordance with these instructions and the use of manufacturer approved accessories only.

WARNING

HIGH EARTH LEAKAGE CURRENT: EARTH CONNECTION IS ESSENTIAL BEFORE CONNECTING THE INPUT SUPPLY.

This equipment must be earthed in accordance with local electrical authority codes of practise.

Caution

This equipment can be fitted with RFI suppression filters (optional).

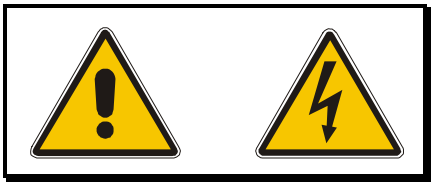
Earth leakage current exceeds 3.5 mA and is less than 1000 mA.
Transient and steady-state earth leakage currents, which may occur when starting the equipment, should be taken into account when selecting instantaneous RCCB or RCD devices.
Residual Current Circuit Breakers (RCCBs) must be selected sensitive to DC unidirectional pulses (class A) and insensitive to transient current pulses.

Note also that the earth leakage currents of the load will be carried by this RCCB or RCD.

WARNING

This system has a signal available for use with an automatic device, externally located, to protect against backfeeding voltage through the mains Static Bypass circuit. If this protection is not used with the switchgear that is used to isolate the bypass circuit, a label must be added at the switchgear to advise service personnel that the circuit is connected to a UPS system.
The text is the following or equivalent:

ISOLATE THE UNINTERRUPTIBLE POWER SYSTEM BEFORE WORKING ON THIS CIRCUIT.



The warning triangle indicates all the personal safety instructions.

Follow these instructions carefully to avoid injury.

General

As with other types of high power equipment, dangerous voltages are present within the UPS and battery enclosure. The risk of contact with these voltages is minimized as the live component parts are housed behind a hinged, lockable door. Further internal safety screens make the equipment protected to IP20 standards.
No risk exists to any personnel when operating the equipment in the normal manner, following the recommended operating procedures.
All equipment maintenance and servicing procedures involve internal access and should be carried out only by trained personnel.

Batteries

Battery manufacturers supply details of the necessary precautions to be observed when working on, or in the vicinity of, a large bank of battery cells. These precautions should be followed implicitly at all times.
Particular attention should be paid to the recommendations concerning local environmental conditions and the provision of protective clothing, first aid and fire-fighting facilities.

WARNING

Follow these instructions scrupulously:

The Liebert Hipulse E is designed exclusively for indoor use. Protect the unit from excessive condensation and install it in a place free of flammable liquids, gases and corrosive substances.
Electrical installation must be performed by a qualified electrician.
Personnel working with the equipment described in this manual must be thoroughly familiar with the product.
Before making connections inside the unit, make sure that all incoming power sources are de-energised and insulated.
When the incoming power source is active, the unit contains a dangerous level of voltage, even when it has "maintenance bypass" status.
To insulate the unit, turn it off and insulate all incoming power sources and auxiliary power sources.

Information for the protection of the Environment

1. *This product has been designed to respect the environment.*
2. *UPS recycling at the end of service life.*
3. *The battery contains small amounts of toxic materials. Lead is a dangerous substance for the environment if it is not properly recycled by specialized companies.*
4. *UPS packing materials must be recycled in compliance with all applicable regulations.*
5. *Unit functioning: use "Ecomode" function whenever possible to reduce energy consumption.*
6. *Unit servicing: this unit makes use of components dangerous for the environment (electronic cards, electronic components and batteries). The components removed must be taken to specialized collection and disposal centers.*
7. *Unit dismantling: in case of unit dismantling, this operation shall be carried out by specialized personnel. The unit must be taken to centers specialized in collection and disposal of dangerous substances.*

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Support Information:

If you require assistance for any reason, please have the following information available:

- Model and size
- Part number
- Serial number
- Date installed
- Location
- Voltage & Frequency
- Battery reserve time

Installation Manual

1 Chapter 1 - Installation Procedure

1.1 Introduction

WARNING

Do not apply electrical power to the UPS equipment before the arrival of the commissioning engineer.

WARNING

The UPS equipment should be installed by a qualified engineer in accordance with the information contained in this chapter and all equipment not referred to this manual is shipped with details of its own mechanical and electrical installation.

WARNING

Battery hazards

Special care should be taken when working with the batteries associated with this equipment. When connected together, the battery terminal voltage will exceed 400 VDC and is potentially lethal.

Eye protection should be worn to prevent injury from accidental electrical arcs.
Remove rings, watches and all metal objects.
Only use tools with insulated handles.
Wear rubber gloves.

If a battery leaks electrolyte, or is otherwise physically damaged, it must be replaced, stored in a container resistant to sulfuric acid and disposed of in accordance with local regulations.

If electrolyte comes into contact with the skin the affected area should be washed immediately with water.
For more details, see Chapter 3 'Battery Installation'

Note

The UPS System can also be connected to an IT (isolated neutral) power system.

This section describes the UPS system's environmental requirements and mechanical considerations that must be taken into account when planning the positioning and cabling of the UPS equipment.

Because every site has its peculiarities, it is not the aim of this chapter to provide step-by-step installation instructions, but to act as a guide as to the general procedures and practices that should be observed by the installing engineer.

1.2 Environmental considerations

1.2.1 UPS location

The UPS module should be located in a cool, dry, clean-air environment with adequate ventilation to keep the ambient temperature within the specified operating range (see Chapter 5 — UPS Environmental).
All models in the Liebert Hipulse E UPS range are cooled with the aid of internal fans.
Cooling air enters the devices through the ventilation grids located at various points on the cabinet and is released through the grids on the roof. To permit air to enter and exit and prevent overheating or malfunctioning, do not cover the ventilation openings.
When the cabinet is located on a raised floor, and bottom cable entry is used, additional cooling air also enters the UPS via the floor void. If necessary, a system of extractor fans should be installed to aid cooling-air flow, and a suitable air filtration system used where the UPS is to operate in a dirty environment.

Note 1: When batteries are cabinet-mounted adjacent to the UPS module, it is the battery which dictates the designed maximum ambient temperature, not the UPS.

Note 2: Power losses from the System which may be used in an air conditioning system are intended for operation using the Inverter, as in the ECOMODE configuration they would be undersized.

Air filters:
The optional dust filters can be installed behind the air intake in the front door(s). By opening the front door, the filters can be changed easily without exposing personnel to high voltage. A schedule for inspection of the air filters is required. The period between inspections will depend upon environmental conditions.

1.2.2 Battery location

Temperature is a major factor in determining the battery life and capacity. Battery manufacturers quote figures for an operating temperature of 20°C. Operating above this temperature will reduce the battery life, operation below this temperature will reduce the battery capacity. On a normal installation the battery temperature is maintained between 15°C and 25°C. Batteries should be mounted in an environment where the temperature is consistent and even over the whole battery. Keep batteries away from main heat sources or main air inlets etc.
If the batteries are rack-mounted, or otherwise located remote to the main UPS cabinet, a battery circuit breaker must be mounted as close as possible to the batteries themselves, and connected using the most direct route possible.
The battery circuit breaker controller board (P\N° 4520079F) must be used in conjunction with the battery circuit breaker.
This control board, which should be located near to the battery circuit breaker, interfaces with the UPS control system.

1.2.3 Storing

If unit is to be stored before installation, it is recommended to store the unit in a dry environment with temperatures in the range of -25°C to 70°C. Use original packing materials or other suitable means to keep the unit clean.

1.3 Mechanical Considerations

1.3.1 System composition

A UPS system can comprise a number of equipment cabinets, depending on the individual system design requirements - e.g. UPS cabinet, External Bypass cabinet. In general, all the cabinets used in a particular installation are of the same height and designed to be positioned side-by-side to form an aesthetically appealing equipment suite.
Refer to the drawings provided in Chapter 6 for the positioning of the cabinets described below.

1.3.2 Frame and enclosure

The UPS is housed in an IP20 enclosure, designed for floor mounting. The top and side removable panels are secured to the chassis by screws. The door can be opened to give access to the power connections bars, auxiliary terminal blocks and power isolators. Front door can be opened at 180° for better Service and more flexibility in installations. The UPS comes with an operator control panel, which provides basic operational status and alarm information. The cabinet houses the power components, control boards and fuses. The cabinet is structurally designed to handle lifting from the base. Cooling is by internal removable fans.

1.3.3 300 kVA UPS with rectifier 6 pulses

The 300 kVA UPS consists of a single cabinet.

1.3.4 300 kVA UPS with rectifier 12 pulses

While the 6 pulse 300 kVA UPS consists of a single cabinet, the 12 pulse 300 kVA UPS is divided into two cabinets for easier transport and positioning at the installation site; one cabinet contains the standard UPS sections, while the other contains the section including the second rectifier bridge, the magnetic components and the control circuits.
Once the equipment is in position, and before it is anchored in place permanently, make the electrical power and auxiliary connections and mechanically join the two cabinets of the UPS.

1.3.5 400 kVA UPS with rectifier 6 pulses

The 400 kVA UPS is split into two cabinets to allow easier transportation and positioning, one houses the Inverter and the other houses the Rectifier/Static Bypass. Once the equipment is positioned and prior to fixing the equipment in place, the two cabinet have to be bolted together and the interlinking power and control cable connections made.

1.3.6 400 kVA UPS with rectifier 12 pulses

The 12 pulse 400 kVA UPS also consists of two cabinets, but while it has the same overall length as the 6 pulse version, it incorporates the 12 pulse section in the Rectifier/ Static Bypass cabinet.

1.3.7 Moving the cabinets

The route to be travelled between the point of arrival and the unit's position must be planned to make sure that all passages are wide enough for the unit and that floors are capable of supporting its weight (for instance, check that doorways, lifts, ramps, etc. are adequate and that there are no impassable corners or changes in the level of corridors).

WARNING

Ensure any lifting equipment used in moving the UPS cabinet has sufficient lifting capacity.

EXERCISE EXTREME CARE WHEN HANDLING UPS CABINETS TO AVOID EQUIPMENT DAMAGE OR INJURY TO PERSONNEL.

Ensure that the UPS weight is within the designated surface weight loading (Kg/cm^2) of any handling equipment. See the UPS specification for weight details - see Table 5-3.
UPS and optional cabinets (battery cabinets, top cable entry cabinets, etc.) can be handled by means of a fork lift or similar equipment. For operations with a fork lift, it is necessary to remove either the lower protection panel located at the base of the cabinet and rear panels (or both side panels). Be aware of the location of the *load supporting feet* so as not to damage them, refer to installation drawings in Chapter 6.
In the eventuality that the equipment cannot be moved by fork lift, then rollers should be used.
Because the weight distribution in the cabinet is uneven, use extreme care during handling and transporting.
When moving the unit by forklift, lift the unit from the rear so as to protect the front panel. Do not exceed a 15 degrees tilt with the forklift. Bottom structure will support the unit only if the forks are completely beneath the unit.
The handling with straps is not authorised.
Note: Do not move the battery cabinet with the batteries fitted.

1.3.8 Clearances

Liebert Hipulse E has no ventilation grills at either side or at the rear of the UPS. To enable routine tightening of power terminations within the UPS, it is recommended that service access of 800 mm (minimum) be allowed for at the rear. Clearance around the front of the equipment should be sufficient to enable free passage of personnel with the doors fully opened. It is important to leave a distance of 800 mm between the top of the UPS and the ceiling of the room in which it is installed to permit adequate circulation of air coming out of the unit.

1.3.9 Floor installation

The installation diagrams in Chapter 6 of this manual identify the location of the holes in the base plate through which the equipment can be bolted to the floor. If the equipment is to be located on a raised floor it should be mounted on a pedestal suitably designed to accept the equipment point loading. Refer to the base view to design this pedestal.

1.3.10 Fixing of the magnetic components

Before the equipment is in place, remove the transportation restraints that hold the input inductance and output transformer in place.

1.3.11 Cable entry

Cables can enter the UPS cabinet from bottom or through both sides.
Side entry is made possible by removing an *optional* grille kick plate fitted in the side panel to reveal the cable entry holes. This cable entry method allows the equipment to be positioned on a solid floor without the need for cable trenching and allows cables to pass from one module to the other when positioned side-by-side.

Note *When selecting the power cables for side entry to a module located on a solid floor, consideration must be given to the minimum permissible radius of the proposed cables to ensure that they can be fashioned to reach the UPS connection busbars.*

1.3.12 Top Cable entry

Optionally a top cable entry extension may be used, see the figures in Chapter 6.
The cabinet extends the overall width of the UPS and permits connection of all incoming AC/DC power cables from above through horizontally supported copper bars.
The top cable entry option is fitted on the side of the UPS cabinet and is supplied without side panels; the side cover from the UPS being used.

The cabinet with cables coming in from the top for the 300 kVA UPS must be positioned on the right side, whereas the cabinet for the 400 kVA UPS must be positioned on the left side.

This facilitates cable entry through the top aluminium panel after the appropriate cable entry holes have been cut. Roof-mounted eyebolts are fitted on shipment to optional cabinet, to enable the cabinet to be crane-handled. These can be removed once the equipment has been finally positioned.
Note 1: The top cable entry also includes the power connection cables between the cabinet and the UPS.

Note 2: For special installation requirements regarding the position of the optional unit for incoming cables entering from the top, special alternatives to the standard position are available.

1.4 Preliminary Checks

Before you install the UPS hardware you should carry out the following preliminary checks:

1. Verify that the UPS room satisfies the environmental conditions stipulated in the equipment specification, paying particular attention to the ambient temperature and air exchange system.
2. Remove any packaging debris, then visually examine the UPS and battery equipment for transit damage, both internally and externally. Report any such damage to the shipper immediately.

1.4.1 Identification

The equipment supplied has an identification tag on the back of the main door reporting:
the type, size, and main calibration parameters of the UPS. A metal disk fastened to the inside top of the cabinet is engraved with its serial number.

Record the model and serial numbers in the table at the beginning of this installation manual. A record of this information is necessary should servicing be required.

2 Chapter 2 - Installation (Electrical)

The UPS requires both «power» and «control» cabling once it has been mechanically installed. All «control» cables, whether screened or not, should be run separate from the power cables in metal conduits or metal ducts which are electrically bonded to the metalwork of the cabinets to which they are connected.

2.1 Power Cabling

WARNING

BEFORE CABLING-UP THE UPS, ENSURE THAT YOU ARE AWARE OF THE LOCATION AND OPERATION OF THE EXTERNAL ISOLATORS THAT CONNECT THE UPS INPUT/BYPASS SUPPLY TO THE MAINS DISTRIBUTION PANEL.
CHECK THAT THESE SUPPLIES ARE ELECTRICALLY ISOLATED, AND POST ANY NECESSARY WARNING SIGNS TO PREVENT THEIR INADVERTENT OPERATION.

For cable entry, refer to section 1.3.11.

2.1.1 System Configuration

The main factors affecting the choice and size of cable are voltage, current (also taking into account overcurrent), room temperature and conditions of installation of the cable.

Note: Correct cable size must also take into account the system's overload capacity (see Chapter 5 – Technical Specifications: - Electrical Characteristics).

The power cables of the system must be size with respect to the following description:

Module input cables
The module input cables must be sized for the maximum input current, including the maximum battery recharge current, given in table 2-1, with respect to the module rating and the input a.c. voltage.

WARNING (300 kVA UPS)

Note 1: *For split Bypass operation ensure that the busbars (*) between Bypass and Rectifier input are removed.*

Note2: *With a Class 'A' EMC filter (optional) and a 'common' input configuration, the capacitors on the Rectifier input bars must be removed.*

WARNING (400 kVA UPS)

Note: *for a common input power configuration (single supply) interconnecting cables are required, connecting the rectifier input with the bypass input* ***(links about 1.5m long)****, with cables sized for the maximum input current in table 2-1.*

Module Bypass and output cables
The bypass and output cables must be sized for the nominal output current, given in table 2-1, with respect to the module rating and the output a.c. voltage.
Battery cables
Each UPS module has its own battery, which is connected using two cables, one positive and one negative. The battery cables must be sized for the battery discharge current at the end-of-discharge voltage, as given in table 2-1 with respect to the module rating.

2.1.2 Table for determining power cable size

This table gives nominal currents for determining the size of UPS power cables. Other factors, which must be taken into consideration, include cable route length, coordination with protective devices, etc. The power cables can be sized to suit the UPS module rating according to the table below:

UPS RATING (kVA)	NOMINAL CURRENT: Amps							BUSBAR STUD SIZE			
	Input Mains with full battery recharge (subtract 5% for 12-pulse)			Bypass\Output at full load			Battery at minimum battery voltage (400Vac) [Note *]	Input/ Cables	Bypass/ Output Cables	Battery Cables	Torque Load (Nm)
	380V	400V	415V	380V	400V	415V					
300	632	600	578	470	446	430	775	M12 (Bolt) Ø13 (holes)			45
400	842	800	771	627	595	574	1030	M12 Ø13	M10 Ø11	M12 Ø13	45 (M12) 26 (M10)

Table 2-1 UPS Module cabinet power cable rating

Note*: Maximum battery discharge current at 380VAC supply increase by 3%, and for a 415VAC supply decrease by 3%

Note: The above values are referred to PF 0.8. Refer to Marketing Technical Specification for option XTreme PF 0.9 or 1.0.

2.1.3 General Notes

The following are guidelines only and superseded by local regulations and codes of practice where applicable:

1. Take special care when determining the size of the neutral cable, as current circulating on the neutral cable may be greater than nominal current in the case of non-linear loads. Refer to the values given in the 'UPS Electrical characteristics' table in Chapter 5.
2. The earth conductor should be sized according to the fault rating, cable lengths, type of protection, etc. The earth cable connecting the UPS to the main ground system must follow the most direct route possible.
3. Consideration should be given to the use of paralleled smaller cables for heavy currents, as this can ease installation considerably.
4. When sizing battery cables, a maximum volt drop of 3Vd.c. is permissible at the current ratings given in Table 2-1.
5. In most installations, especially those concerning parallel multi-module systems, the load equipment is connected to a distribution network of individually protected busbars fed by the UPS output rather than being connected directly to the UPS itself. Where this is the case the UPS output cables can be rated to suit the individual distribution network demands rather than being fully load-rated.
6. When laying the power cables, do not form coils, so as to avoid increasing formation of electromagnetic interference.
7. In parallel multi-module systems, the output cable of each unit should be kept as equi-distant as possible between the unit output terminals and the parallel distribution busbar to prevent from affecting the shared current.

2.1.4 Cable connections

The rectifier input, bypass, output and battery power cables (all require lug type terminations) are connected to busbars situated below the power isolator switches - as shown in Chapter 6. These are accessible when the power compartment cover plate is removed.
A terminal block X3 is used for connecting the control cables to the battery circuit breaker and a second terminal block X4 is used for the external emergency stop facility, external OFF inverter, ext. Bypass, etc. these are female spade type connections (Fast-on 6,3 x 0,8) and are described later in Section 2.3.

2.1.5 Safety earth

The safety earth bus-bar is located near the input and output power supply connections as shown in Chapter 6. The safety earth cable must be connected to the earth bus-bar and bonded to each cabinet in the system.
All cabinets and cable trunking should be earthed in accordance with local regulations.

Note: *Proper grounding considerably reduces problems in systems caused by electromagnetic interference.*

WARNING

FAILURE TO FOLLOW ADEQUATE EARTHING PROCEDURES CAN RESULT IN ELECTRIC SHOCK HAZARD TO PERSONNEL, OR THE RISK OF FIRE, SHOULD AN EARTH FAULT OCCUR.

2.1.6 Protective devices

For safety reasons, it is necessary to install, external to the UPS system, circuit breaking protective devices in the input a.c. supply and towards the battery. Given that every installation has its own characteristics, this chapter provides general useful information for qualified installation engineers, with knowledge of operating practices, of regulatory standards, and of the equipment to be installed.

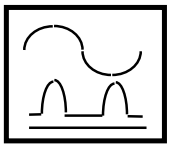
Rectifier and Bypass input supply of the UPS:

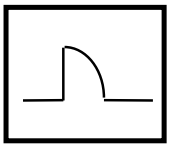
Protection against excessive overcurrents and short circuits in the mains supply input:

These inputs must be protected, installing suitable protective devices at the distribution panel of the incoming main supply, considering that the protection should discriminate with overload capacity of the system (see Chapter 5 — Specification: - Electrical Characteristics).

Split bypass: in the case of a split bypass being used, separate protective devices should be installed in the incoming mains distribution panel.
The protective devices must be selected for the nominal input current, with respect to the UPS rating and the input a.c. supply voltage as given in table 2-1.

Protection against earth faults (RCD devices):
In the event of a differential (RCD) device being installed upstream of the input supply, one must take into account the transient and steady state earth leakage currents that are produced during start-up of the UPS.
The presence of an RFI suppression filter inside the UPS, determines a residual earth current greater than 3.5 mA and less than 1000 mA.
Residual current circuit breakers (RCCB) must be sensitive to d.c. unidirectional pulses (class A) in the network and insensitive to transient current pulses.
They are identified by the symbols respectively:





These isolators must have an average sensitivity, possibly adjustable between 0.3 and 1A.
It is recommended that the selectivity with every differential switch be verified both upstream of the input distribution board and downstream (towards the load).

Parallel 1+N:

Use of differential circuit breakers on UPS unit inputs in a configuration with separate inputs and one battery for each unit requires installation of a common device only on the system bypass mains.
Use of differential circuit breakers on UPS unit inputs sharing a common battery requires installation of a device common to all the input lines. If inputs are configured for separate mains, a common device will also be required for all System bypass mains.

UPS Battery:

The UPS Battery is protected by means of a control circuit that operates the tripping mechanism of an automatic circuit breaking device (having a variable trip setting). The tripping mechanism using an undervoltage release coil that operates on a preset minimum voltage level.

The circuit breaker is essential for maintenance of the battery and is normally located near to the battery installation. The characteristics and operation of the automatic circuit breaker are given in Chapter 3.

Output of the System:

In the eventuality that an external distribution panel is used for load distribution, the selection of protective device must provide discrimination with those that are used at the input to the UPS module.

2.1.7 Cabling procedure for 300 kVA UPS with 6 pulse rectifier (or 12 pulse rectifier)

Note on 12-pulse UPS: before proceeding with wiring procedures, make the connections between the two cabinets, referring to the detailed description provided in section 2.1.8 – *12-phase wiring procedure (for300 kVA UPS).*

Once the equipment has been finally positioned and secured, connect the power cables as described in the following procedure.

Study the connection diagram as illustrated in Chapter 6.

1. Verify that the UPS equipment is totally isolated from its external power source and all the UPS power isolators are open. Check that these supplies are electrically isolated, and post any necessary warning signs to prevent their inadvertent operation.
2. Open the door(s) to the UPS cabinet and remove the lower protective cover to gain access to the connections bars. The protective cover on the UPS cabinet must be removed subsequent to removal of the handles on the power isolators.
3. Connect the safety earth and any necessary bonding earth cables to the copper earth busbar located on the floor of the equipment below the power connections.

   The safety earth cable must be connected to the earth busbar and bonded to each rack\cabinet in the system.

   Note: The earthing and neutral bonding arrangement must be in accordance with local and national codes of practice.

Common Input Connections

4. For common bypass and rectifier inputs, connect the **a.c. input supply** cables between the mains distribution panel and the UPS bypass input supply busbars (U3-V3-W3-N3 terminals) and tighten the connections to 45 Nm (M12 Bolts).

   Note: With a Class 'A' EMC filter (optional) and a 'common' input configuration, the capacitors on the Rectifier input bars must be removed.

ENSURE CORRECT PHASE ROTATION.

Split Bypass Connections

5. If a 'split-bypass' configuration is used, connect the **a.c. input supply** cables to the **rectifier input busbars** (U1-V1-W1 terminals) and the **a.c. bypass supply** cables to the **bypass input basbars** (U3-V3-W3-N3 terminals) and tighten the connections to 45 Nm (M12 Bolts).

WARNING

Ensure that any links (❋) fitted between rectifier input and bypass busbars are removed (see figures 6.1.10)

ENSURE CORRECT PHASE ROTATION.

Output System Connections

6. Connect the system **output cables** between the **UPS output busbars** (U2-V2-W2 N2 terminals) and the **critical load** and tighten the connections to 45 Nm (M12 Bolt).

ENSURE CORRECT PHASE ROTATION.

WARNING

If the load equipment will not be ready to accept power on the arrival of the commissioning engineer then ensure that the system output cables are safely isolated at their ends.

UPS Battery Connections

7. Connect the **battery cables** between the UPS terminals (+\-) and its associated **battery circuit breaker** (as shown in Chapter 6).

   Note: When connecting the cables between the battery extremities to the circuit breaker always connect the circuit breaker end of the cable first.

   The auxiliary cables of the battery must be **screened and double insulated**. Connect screened auxiliary cables from each **battery circuit breaker controller board** (P/N 4520079F) to the **UPS auxiliary terminal block** (X3) (as shown in Chapter 6) of their metal frame of the Battery circuit breaker box (if used), not of UPS.

OBSERVE THE BATTERY CABLE POLARITY.

WARNING

Do not close the Battery circuit breaker before the equipment has been commissioned

Auxiliary Connections

8. Connect the auxiliary cables of any external interface/signals to the respective connections of the output auxiliary terminal block (X4) (see Chapter 6).

9. Refit the lower metal protective cover and the handles on the UPS power isolators.

2.1.8 12-phase wiring procedure (for 300 kVA UPS)

Important

The operations described in this section must be performed by authorised electricians or qualified technical personnel. If you have any difficulties do not hesitate to contact our Customer Service & Support department at the address given at the beginning of this manual.

12 Pulse UPS

Once the equipment is in position, and before it is anchored in place permanently, make the electrical power and auxiliary connections and mechanically join the two cabinets of the (12 pulse) UPS.
Refer to the drawings provided in Chapter 6 for guidance during connection.

Power connections

1. Connect the wires provided (+\-) from the UPS rectifier bridge to the connection bar of the second rectifier bridge (optional 12 pulse cabinet). The wire numbered 215 (+) must be connected to the positive bar, while the wire numbered 214 (-) must be connected to the negative bar. Perform the connection in the order specified.
2. Connect the wires provided (205\206\207) from transformer T2 (in the optional 12 pulse cabinet) to the L1 - A'\B'\C' inductor connection bar on the UPS. The wire numbered 205 must be connected to the terminal marked A', wire 206 to B', and wire 207 to C'. Perform the connection in the order specified.

Auxiliary connections

3. Insert the flat cable (W13) provided in the optional 12 pulse cabinet to the fixed connector (X4) on the Rectifier Logic card (code 4520074A) in the UPS cabinet. Follow connection directions precisely.
4. Insert the loose connectors provided in the UPS cabinet to the fixed connectors in the optional 12 pulse cabinet. The loose connector (X25) must be inserted in the fixed 6-way connector; repeat the same operation for the loose connector (X24) on the fixed 4-way connector.

5. The two units must be positioned side by side and bolted together using the holes on the uprights at the sides of the cabinet.

6. Proceed to make input connections as described in the previous section.

2.1.9 Cabling procedure for 400 kVA UPS with 6 pulse rectifier (or 12 pulse rectifier)

Important

The operations described in this section must be performed by authorised electricians or qualified technical personnel. If you have any difficulties do not hesitate to contact our Customer Service & Support department at the address given at the beginning of this manual.

Once the equipment is positioned and prior to fixing the equipment in place, it is necessary to make the electrical and auxiliary connections between the two cabinets that make up the UPS.

Electrical power connections and auxiliary connections between the two cabinets must be made from the front of the UPS.

Refer to the drawings provided in Chapter 6 for guidance during connection.

Power connections between the rectifier cabinet and the inverter cabinet

1. Open the inside doors to access the cabinet connection bars.
2. Connect the copper plaits supplied coming out of transformer T1 in the inverter cabinet to the connection bars located alongside the right-hand rear upright of the static switch cabinet. First connect plait 18 from 'T1-c' to terminal I3 of the static switch unit; next connect plait 17 from 'T1-b' to terminal I2, then connect plait 16 from 'T1-a' to terminal I1 of the static switch unit, and finally connect plait 25 from 'T1-N' to the Neutral bar. Perform the connection in the order specified.
3. Connect the prepared plaits (+/-) already supplied coming out of the UPS rectifier bridge to the inverter cabinet connection bar. Be careful to comply with connection polarity.
   Note: Make all connections with a torque of 45 Nm for M12 bolts.

Auxiliary connections between the rectifier cabinet and the inverter cabinet

Open the inner door on the left side of the inverter cabinet and make the following auxiliary connections:

4. Connect the ribbon cables already fitted in the inverter cabinet to the respective connectors in the rectifier cabinet. The ribbon cable W20 must be connected to X47, while the ribbon cable W21 must be connected to X48. Respect the indications of these connections rigorously.
5. Connect the loose lead cables in the inverter cabinet to their respective connectors in the rectifier cabinet. The loose lead cables X39 is connected to 12 way connector socket; repeat the same operation for the loose lead cable X40, connecting to the 4 way connector socket.

Once the equipment has been finally positioned and secured, connect the power cables as described in the following procedure.

Study the connection diagram as illustrated in Chapter 6.

6. Verify that the UPS equipment is totally isolated from its external power source and all the UPS power isolators are open. Check that these supplies are electrically isolated, and post any necessary warning signs to prevent their inadvertent operation.
7. Open the door(s) to the UPS cabinet and remove the lower protective cover to gain access to the connections bars.
8. Connect the safety earth and any necessary bonding earth cables to the copper earth busbar located on the floor of the equipment below the power connections.

   The safety earth cable must be connected to the earth busbar and bonded to each rack\cabinet in the system.

   Note: The earthing and neutral bonding arrangement must be in accordance with local and national codes practice.

Common Input Connections

9. For common bypass and rectifier inputs, connect the **a.c. input supply** cables between the mains distribution panel and the UPS **rectifier input busbars** (U1-V1-W1 terminals) and tighten the connections to 45 Nm (M12 Bolt). Additional connecting cables must be used (see note in paragraph 2.1.1) from the **rectifier input bars** (U1-V1-W1) to the **bypass input bars** (U3-V3-W3). The input neutral cable must be connected to the bypass input bar (N3).

   Note: It is important that the connections between the **input cables** from the external distribution box and the **additional cables** (links) are connected to the rectifier input bars (U1-V1-W1).

ENSURE CORRECT PHASE ROTATION.

Split Bypass Connections

10. If a 'split-bypass' configuration is used, connect the **a.c. input supply** cables to the **rectifier input busbars** (U1-V1-W1 terminals) and the **a.c. bypass supply** cables to the **bypass input basbars** (U3-V3-W3-N3 terminals) and tighten the connections to 45 Nm (M12 Bolts).

ENSURE CORRECT PHASE ROTATION.

Output System Connections

11. Connect the system **output cables** between the **UPS output busbars** (U2-V2-W2 N2 terminals) and the **critical load** and tighten the connections to 45 Nm (M12 Bolt).

ENSURE CORRECT PHASE ROTATION.

WARNING

If the load equipment will not be ready to accept power on the arrival of the commissioning engineer then ensure that the system output cables are safely isolated at their ends.

UPS Battery Connections

12. Connect the **battery cables** between the UPS terminals (+\-) and its associated **battery circuit breaker** (as shown in Chapter 6).

    Note: When connecting the cables between the battery extremities to the circuit breaker always connect the circuit breaker end of the cable first.

    The auxiliary cables of the battery must be **screened and double insulated**. Connect screened auxiliary cables from each **battery circuit breaker controller board** (P/N 4520079F) to the **UPS auxiliary terminal block** (X3) (as shown in Chapter 6) of their metal frame of the battery circuit breaker box (if used), not of UPS.

OBSERVE THE BATTERY CABLE POLARITY.

WARNING

Do not close the Battery circuit breaker before the equipment has been commissioned

Auxiliary Connections

13. Connect the auxiliary cables of any external interface/signals to the respective connections of the output auxiliary terminal block (X4) (see Chapter 6).

14. Refit the lower metal protective cover.

2.2 Distance from floor to connection point on the equipment:

UPS	UPS 300 kVA minimum distance (mm)	UPS 400 kVA minimum distance (mm)
Rectifier a.c. Input supply	345	360
Bypass a.c. Input supply	345	480
UPS Output a.c.	345	800
Battery Power	345	460
Auxiliary cables: Battery Control / Temp. Compensation (X3)	570	330
Communications to AS400/External Alarm monitor	750	350
Remote Emergency Power Off (EPO) (X4)	450	400
Earth	350	360

Table 2-2

2.3 Control cables

2.3.1 Battery Control

The battery circuit breaker is controlled by the battery circuit breaker controller board, which is located within the battery cabinet — or adjacent to the battery circuit breaker when the batteries are rack-mounted. This board controls the circuit breaker's undervolt release coil and also provides a path for the circuit breaker auxiliary contacts to signal the circuit breaker status back to the UPS control logic. All connections between the controller board and the UPS module are made via the auxiliary terminal block (X3), which is located in the base of the UPS cabinet.

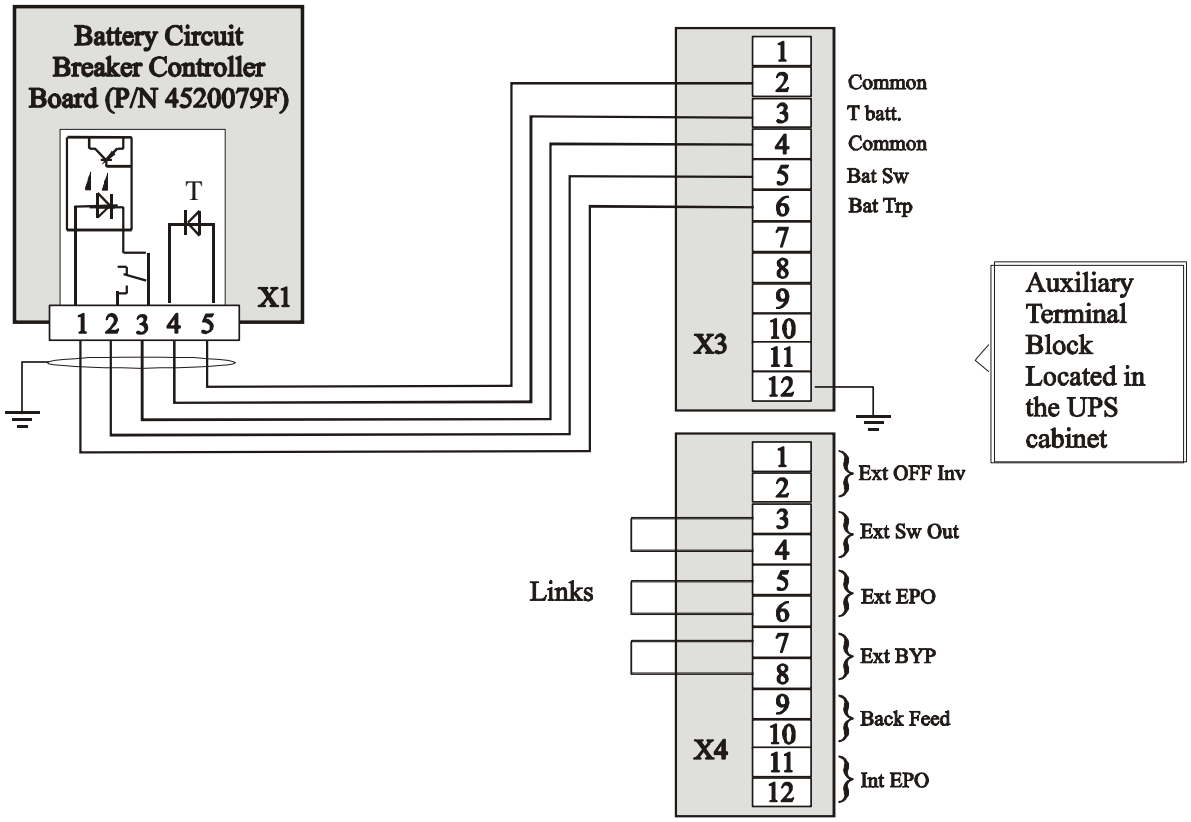


Figure 2-1 Auxiliary terminal block detail

Connect the battery circuit breaker control and temperature compensation cables between the UPS auxiliary terminal block and battery circuit breaker controller board as shown in figure 2-1. These cable must be shielded and double insulated, shield should be connected at protective earth of battery cabinet or battery breaker, not at UPS.

Caution

If battery temperature compensation is not used the system must be de-activated by the commissioning engineer.

Auxiliary terminal block X3 at UPS.

X3 terminal reference	Reference label	Description
2	Common	Temperature sensor common (0V)
3	T Batt.	Temperature sensor signal
4	Common	Common (0V)
5	Batt. Sw	Battery Circuit Breaker open
6	Bat Trp	Battery Circuit Breaker trip control

Table 2-3

Note: The auxiliary cables of the battery must be **screened and double insulated**.
The screen is connected to the earth of the battery circuit breaker cabinet or supporting rack.
Use multiple-core shielded cables with a section of 0.5 to 1 mm^2.
Connect the cables with the Fast-on 6.3x 0.8 mm terminals (female).

2.3.2 Auxiliary terminal block X4

Next to terminal board X3 there is a second terminal board which may be used for auxiliary connection of equipment or devices external to the UPS. Use the following table to identify the terminals corresponding to the equipment or device to be connected.

Auxiliary terminal block X4 at UPS.

X4 terminal reference	Reference label	Description
1-2	Ext. OFF Inv	Remotely provides control for switching off the inverter. The external contact employed must be normally open with the input switch open.
3-4	Ext. Sw Out	Indication to be provided at the UPS to note the opening of an external module output isolator. The external contact employed must be normally open with the output switch open. If unused, leave the standard connectors in place.
5-6	Ext. EPO	Remotely provides control for switching off the UPS using a remote emergency button. Normally closed contact. If unused, leave the standard connectors in place.
7-8	Ext. BYP	Indication to be provided at the UPS to note the opening of an external maintenance bypass switch. The external contact employed must be normally closed with the external maintenance bypass switch open. If unused, leave the standard connectors in place.
9-10	Back Feed	Signal from the UPS to indicate a return flow of energy in the bypass mains. The contact employed is normally open; if it is closed, this means a failure has been detected. Refer to point 2.3.4 on the next page.
11-12	Int EPO	One contact is available for opening an external EPO switch assembled upstream of the UPS. The normally closed contact is opened when the internal emergency button is pressed. See Note 2 on the next page.

Table 2-4

Note: All auxiliary cables of terminal block X4 must be **double insulated**.
The cross-sectional area of the auxiliary cables is from 0.5 to 1 mm^2.
Connect the cables with the Fast-on 6.3x 0.8 mm terminals (female).
Maximum contact rating on auxiliary terminals: 50 Vdc @ 1 Amp.

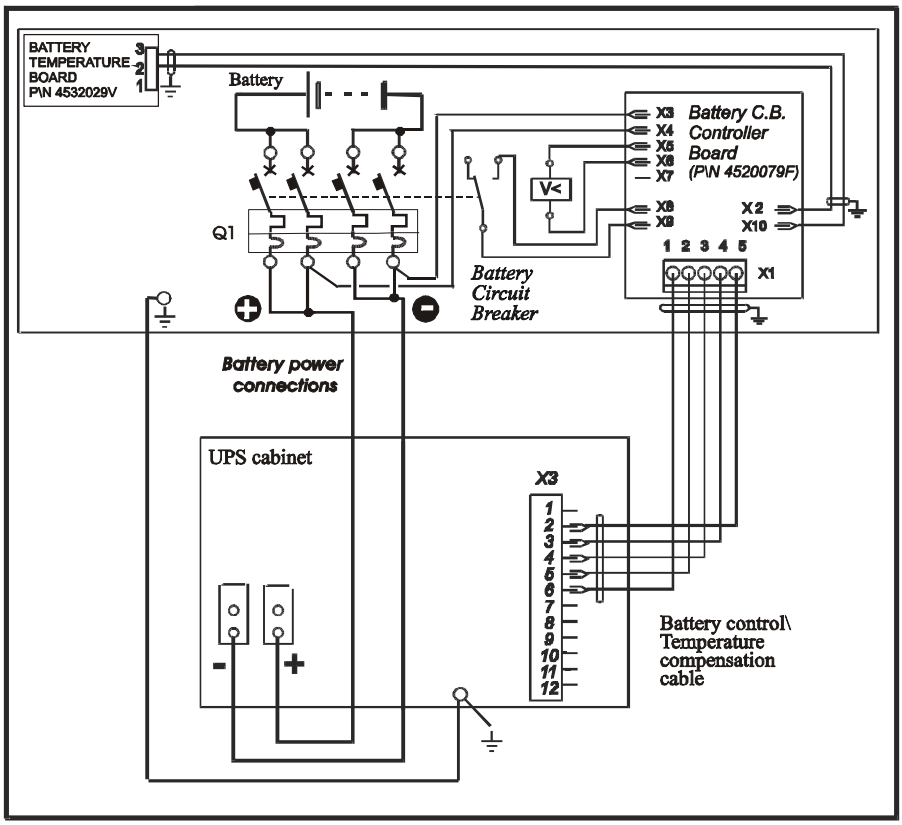


Figure 2-2 Battery Connection

2.3.3 Emergency Stop

If an external Emergency Stop facility is required it is connected to terminals 5 & 6 of the Auxiliary Terminal Block (X4) and connected to the `normally closed' remote stop switch between these two terminals using shielded cable. If this facility is not used then terminals 5 & 6 must be linked-out as shown in Figure 2-1.

Note 1 *The Emergency Stop action within the UPS shuts down the rectifier, inverter and static bypass and trips the battery circuit breaker. It does not however internally disconnect the input mains supply. If required, this additional action can be facilitated by feeding the UPS input via an isolator which can be tripped by a second contact of the Emergency Stop switch.*

Note 2 *Terminals 11 & 12 of the Auxiliary Terminal Block(X4) are connected to a «normally closed» contact of the UPS Display Panel emergency Stop button and go open circuit when the button is pressed. This output can be used as part of a wider Emergency Stop system to initiate an external action (such as tripping an external supply breaker).*

2.3.4 Back Feed Protection

Using an auxiliary terminal (pins 9-10 of connector X4) the UPS provides a normally open contact to be used for opening of an external circuit protection device, to protect the operator against backfeed of energy resulting from a short-circuit fault of the Bypass line SCRs. This auxiliary contact can be used, for example, in series with an external low voltage source, in order to supply the trip coil of an automatic circuit breaking device, located upstream of the UPS Bypass mains input. In the event of energy being backfed the auxiliary circuit will activate closing the normally open contact and as a result opening of the external circuit breaking device; the UPS is disconnected from the Bypass mains supply. The electrical characteristics of the auxiliary contact are 50V (a.c. or d.c.) @ 1 Amp.

3 Chapter 3 - Battery Installation

3.1 Introduction

The UPS battery consists of battery blocks connected in series to provide a nominal d.c. input voltage for the UPS inverter. The required '*AUTONOMY TIME*' (the time that the battery can maintain supply to the load in the event of a mains failure) is limited by the ampere hour size of the individual battery blocks and in some cases this could mean several strings are connected in parallel.
Usually, with UPS installations in the high power range covered by the Hipulse E equipment, the batteries are contained in a dedicated battery room. It must be possible to install batteries of various types and capacity in the battery room to obtain the required autonomy characteristics.

If multiple sets of batteries connected in parallel are used to provide the required battery autonomy, each set should be fitted with an isolating devices to permit work to be performed on one set of batteries while the others remain in service.

It must be possible to disconnect the battery from the UPS module when undertaking maintenance or service procedures. This is facilitated by means of a suitably rated circuit breaker which must be located as close as possible to the battery terminals, and the power and control cables connected to the UPS using the most direct route possible. The circuit breaker can be switched manually ON or OFF but should also contains an under-voltage release mechanism (having a variable trip setting) which is used in conjunction with battery circuit breaker controller board.

For battery room assembly, Liebert offers a battery circuit breaker option (the rating of which depends on the size of the UPS) including a battery circuit breaker controller board (the same for all sizes). This box is designed to be either wall-mounted or assembled on a frame, and is connected between the UPS and the battery. Refer to section 3.8 for more information.
A Common Battery Circuit Breaker is available for systems incorporating two parallel UPSs with a common battery. It comprises two switches, which may be used to section one UPS while the other remains active. Refer to section 4.3 for more information.

3.2 Safety

Special care should be taken when working with the batteries associated with the Hipulse E UPS System equipment. When all the cells are connected together, the battery terminal voltage will exceed 400V and is potentially lethal. A primary safety consideration is to physically isolate the battery installation from all but appropriately qualified maintenance personnel; which is best achieved by locating the cells in a dedicated battery room. Specific battery cabinet and battery room design details are given later in this section.

WARNING

The following general battery safety precautions and WARNINGS should be observed at all times:

a) A battery can present risk of electric shock or burn from high short circuit currents.

b) When connected in a string the voltage could be 460V d.c. this voltage is potentially lethal always observe high voltage precautions.

c) Only qualified personnel should install or service batteries.

d) Eye protection should be worn to prevent injury from accidental electrical arcs.

e) Remove rings, watches, necklaces, bracelets and all metal objects.

f) Only use tools with insulated handles.

g) Wear rubbers gloves and a rubber apron when handling batteries.

h) If a battery leaks electrolyte, or is otherwise physically damaged, it should be placed in a container resistant to sulphuric acid and disposed of in accordance with local regulations.

i) If electrolyte comes into contact with the skin the affected area should be washed with plenty of clean water immediately.

j) Batteries must always be disposed of according to local environmental laws.

k) When replacing batteries use the same number and type that were originally fitted.

l) Disconnect charging source prior to connecting or disconnecting battery terminals.

m) Determine if the battery is inadvertently grounded. If inadvertently grounded, remove source of ground. Contact with any part of a grounded battery can result in electrical shock.

3.3 UPS Batteries

Battery can be VRLA, Ni-Cd or wet cell type.
It is common practice in UPS installations to use valve regulated cells. The term '*valve regulated*' is used currently in place of either '*sealed*' or '*maintenance free*' both of which have been used in the past.
Valve-regulated cells are not 'sealed,' and will vent. The amount of gas given off is less than for a flooded cell but when considering the design of the battery installation allowances must be made for adequate ventilation and heating of the cells. Boost charging must not be applied to valve regulated cells as this will cause them to overcharge and subsequently vent.
Similarly, valve-regulated cells cannot be regarded as 'maintenance-free' as they must be kept clean and their connections checked periodically for tightness and lack of corrosion. It is not possible to check the cells' specific gravity directly but the battery can be checked by the 'CS PG battery service programme' which can give an indication of faulty cells or cell degradation within the battery.
Batteries are fully charged before delivery; however, storage and transportation times mean that, inevitably, some charge is lost by the time the battery is commissioned. All the cells forming the battery should be brought to the same state of charge and be recharged within 6 months of the factory charge.
It is especially important that the battery is fully charged before attempting a witness test of the autonomy time. This may require several days to complete; therefore any witness test concerning the batteries should take place only after the battery has been on uninterrupted float charge for at least one week.
Cell performance typically improves after a few weeks in service or after two or three discharge/recharge cycles.

3.4 Installation design considerations

Note:	*Full safety instructions concerning the use and maintenance of UPS batteries are provided in the appropriate battery manufacturers manuals. The battery safety information contained in this section relates to key considerations which must be taken into account during the installation design process and might affect the design outcome depending on localised conditions.*

3.5 Battery Installation and Maintenance

3.5.1 Temperature considerations

Battery performance depends on the ambient battery temperature. Capacity and autonomy times are quoted for a new battery operating at 20°C. Battery capacity is increased by 1% for every 1°C increase in temperature up to 25°C. If a battery is used at temperatures above 25°C, its life is reduced; consequently its capacity and UPS autonomy time will reduce more rapidly over a period of time. Operating below 20°C will reduce the battery capacity by approximately 1%-1.5% per 1°C. For example: if a battery discharge test is attempted during the middle of winter when the ambient temperature is 5°C the battery capacity will be only 77.5% of its design value and will not satisfy its specified autonomy time.

Ambient temperature, ventilation, spacing, float voltage and ripple current all affect the battery temperature. Uneven temperature distribution through the battery string will cause the voltage distribution to be uneven which can also lead to problems — it is therefore important to maintain a even temperature across the whole battery chain.

'Valve-regulated' cells are very sensitive to temperature and should be operated at a temperature between 15°C and 25°C. To help sustain this operating temperature range the battery is normally float charged at 2.25V/cell.

When batteries are mounted in the same room to the UPS module, it is the battery which dictates the designed maximum ambient temperature, not the UPS. — i.e. in the case of 'valve-regulated' cells the ambient room temperature should be kept between 15°C and 25°C, and *not* between 0°C and 40°C (which is the specified main equipment operating temperature range). Temperature excursions are permissible for short periods of time provided the average temperature does not exceed 25°C.

3.5.2 Battery population

The nominal DC bus voltage, and therefore battery float voltage, is set according the module's rated input/output voltage, and usually set to 432Vdc (380Vac), 446Vdc (400Vac) or 459V (415Vac). Given that the desired cell float voltage is 2.25V, this means that a different number of cells are required in each case (see Chapter 5 - DC Intermediate Circuit).

3.6 Battery protection

The battery is connected to the UPS through a circuit breaker which is manually closed and electronically tripped via the UPS control circuitry. If the cells are rack -mounted (or located remote from the main UPS cabinet), this circuit breaker, fitted within the cabinet, must be positioned as near as possible to the batteries themselves, and the power and control cables connected to the UPS using the most direct route possible. The UPS electronic circuitry will trip the circuit breaker if any of the following conditions occur:-

a) If the d.c. busbar drops below 330V d.c. (This would normally occur during a mains failure when the battery autonomy time has been exceeded.
b) If there is a rectifier problem and the d.c. bus rises above (2.45 V/cell exceeded on the battery).
c) If the Emergency Stop is operated.

Note: All equipment servicing procedures should be carried out only by trained personnel.

3.7 Battery installation

3.7.1 Fitting & connecting the batteries

The following notes, in conjunction with the diagrams, illustrate the broad principles to be followed when fitting and connecting the majority of battery installations.

3.7.2 Fitting the batteries

1. In general a minimum space of 10 mm must be left on all vertical sides of the battery block to permit free air movement around the cells.
2. Clearance should be allowed between the top of the cells and the underside of the shelf above (this is necessary for monitoring and servicing the cells).
3. When installing the batteries on racks always work from the bottom shelf upwards to prevent raising the centre of gravity.

3.7.3 Connecting the battery

1. When the battery circuit breaker cabinet is installed on a raised floor the battery power cables and circuit breaker control cables can be routed to the UPS cabinet via the floor of the cabinet. If the UPS and battery circuit breaker cabinet are located adjacent to each other and located on a solid floor these cables can be passed between the cabinets via the lifting apertures located in the lower sides of the cabinets.
2. In general it is recommended that the inter-connecting cables are fitted to the batteries within their particular level before fitting the inter-level connecting cables, followed finally by the cables to the circuit breaker.
3. An insulating shroud should be fitted to each terminal after its connection has been made.
4. When connecting the cables between the battery extremities to the circuit breaker always connect the circuit breaker end of the cable first.

3.7.4 Battery room design

Whatever the type of mounting system selected, the following conditions should be noted:

❶ Layout of cells:

Whatever battery mounting system is used, the batteries should be laid out in such a manner as to make simultaneous contact with two exposed live parts having a potential greater than 150V impossible. Where this is *not* possible, insulated terminal shields must be installed and insulated cables must be used for connections.

❷ Service platform:

The service platform (or duckboard) must be slip-proof, insulated from the floor and be at least one metre wide.

❸ Connections:

All connections must be as short as possible.

❹ Battery protection circuit breaker:

The battery circuit breaker is generally installed at the front of the battery room. The connection of Circuit Breaker Box available for the Hipulse E is described in the following paragraph.

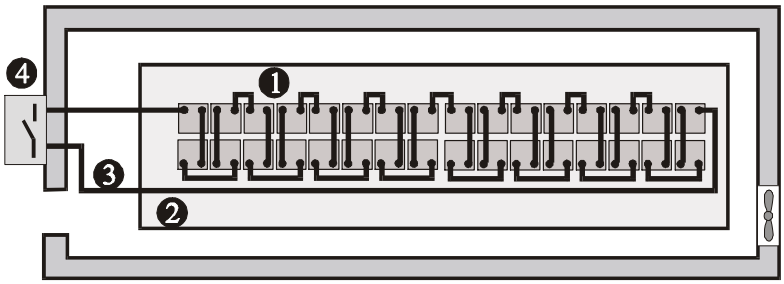


Figure 3-1 Battery Room Design

3.8 Battery circuit breaker box

The box contains a battery isolating circuit breaker and the circuit breaker controller board (P/N 4520079F) as also mounted in the Battery cabinet.
A range of battery circuit breaker boxes is available for use in installations where the battery is not installed in the battery cabinet, in which case the appropriate battery box is fitted as close as possible to the battery and connected to the UPS equipment as illustrated in Figure 3-4.

The battery circuit breaker box, used with the circuit breaker controller board, is required to protect the battery from deep discharging and overcurrents. It also provides electrical isolation between the UPS and the battery, permitting technical service personnel to reduce the risks involved in maintenance work to a minimum. Inside the box are connection bars for power cables arriving from the UPS and from the battery.

Note: The control cables from the UPS module to the controller board must be made using a 5-core shielded cable located in a separate conduit to that containing the battery power cables.
The control signal cable is connected to the circuit breaker controller board (P/N 4520079F) through the terminal board (X1).
The cable shield must be earthed to prevent induced noise affecting the control operation, and a separate safety earth must be connected between the UPS module and Circuit Breaker Box.

The battery circuit breaker boxes are of the same size (save for height) for both the 300 kVA and the 400 kVA UPS, but switch capacity and the section of the connection bar are different.

UPS (kVA)	Dimensions (H-W-D) (mm)	Weight (Kg)	Circuit Breaker	Cable entry
300	800x600x300	41	800A 4p	Bottom
400	1000x600x300	47	1000A 4p	Top & bottom

For mechanical details refer to the information shown in the following figures.

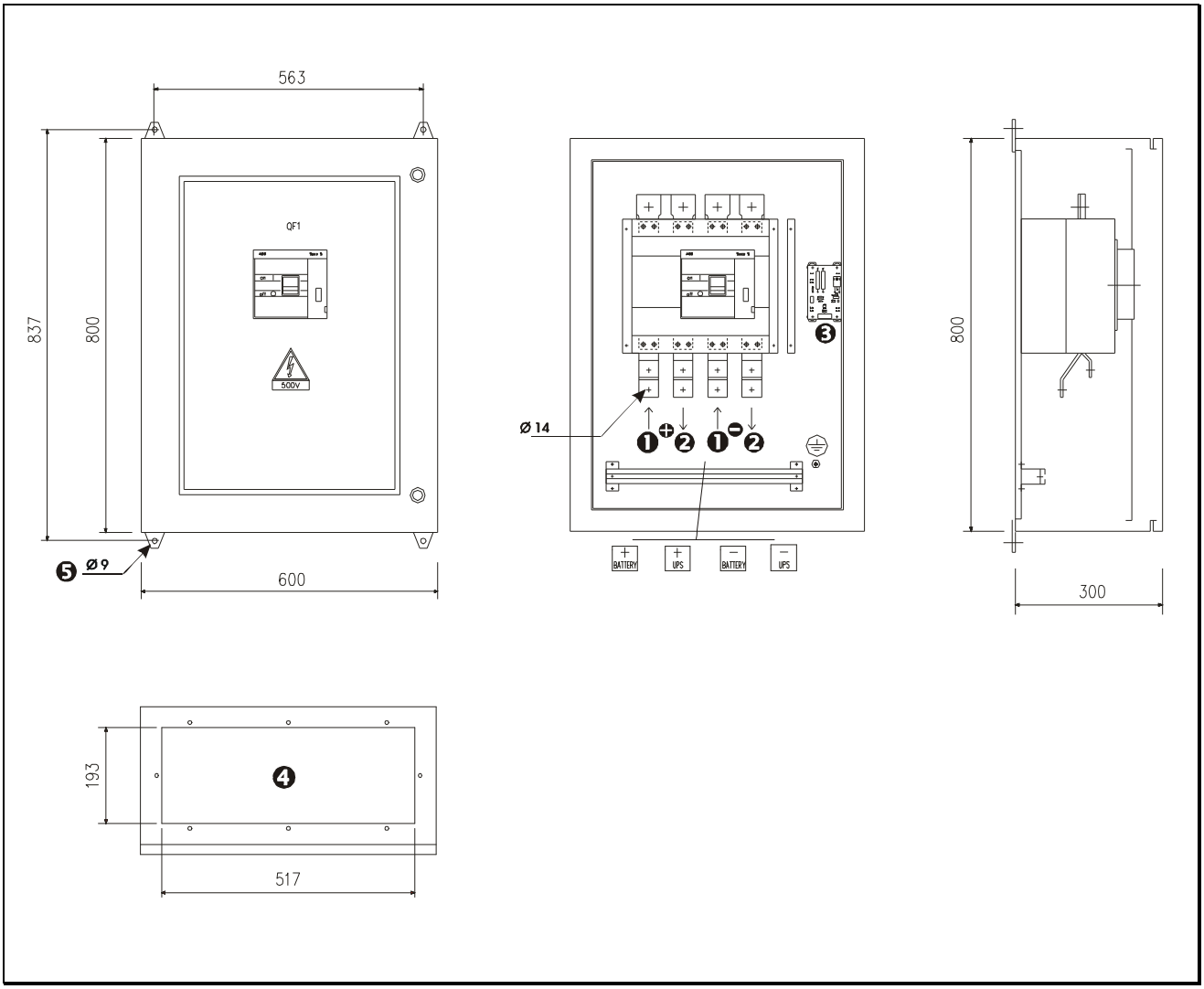


Figure 3-2 Battery circuit breaker box - 800A

BCB 800A

	LEGEND
❶	Battery connections (+/-)
❷	Connections from UPS (+/-)
❸	Battery circuit breaker controller board
❹	Cable entry: bottom. User to size and cut holes for the cables to be used.
❺	Wall mounting holes

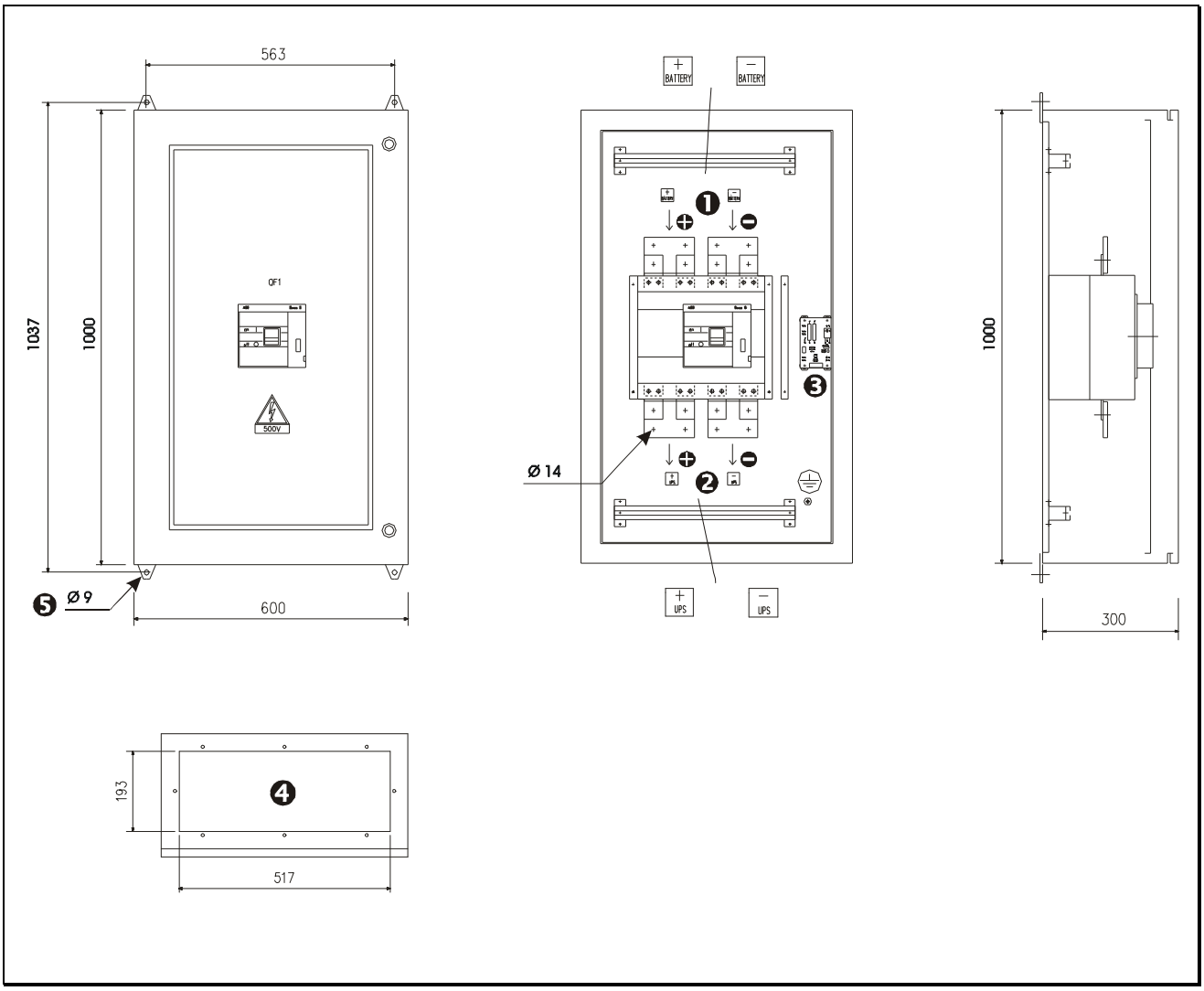


Figure 3-3 Battery circuit breaker box - 1000A

BCB 1000A

	LEGEND
❶	Battery connections (+/-)
❷	Connections from UPS (+/-)
❸	Battery circuit breaker controller board
❹	Cable entry: top and bottom. User to size and cut holes for the cables to be used.
❺	Wall mounting holes

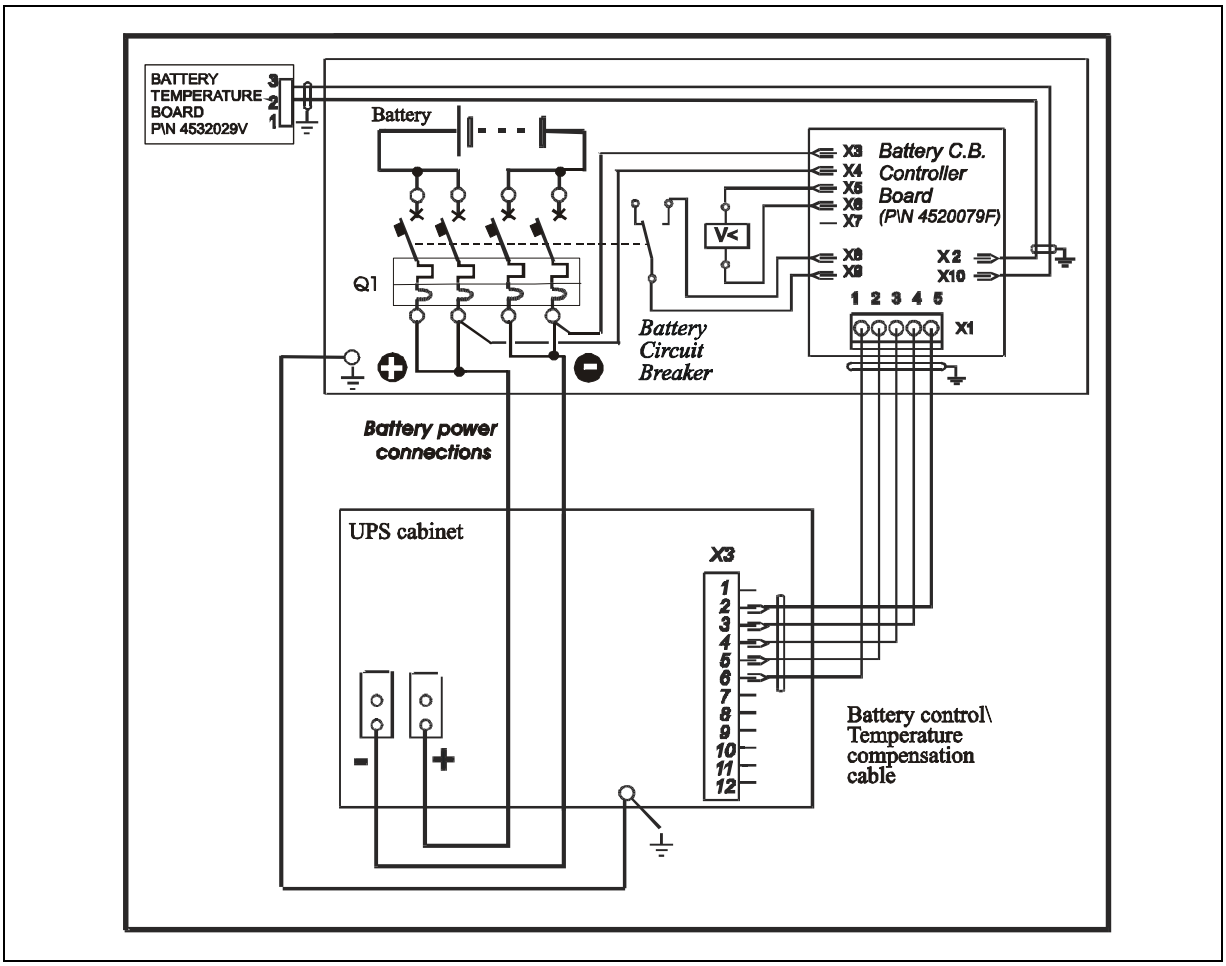


Figure 3-4 Battery circuit breaker box connection

3.8.1 Battery Temperature Board (Optional P/N 4532029V)

A battery temperature sensor card, supplied separately from the battery circuit breaker, is connected with the UPS logic through the battery circuit breaker control card.
With this feature fitted, the nominal float voltage supplied to the battery is adjusted so as to be inversely proportional to the ambient battery cabinet/room temperature. This prevents the battery being over charged at high ambient temperatures.

4 Chapter 4 - 1+N System

4.1 General

The 1+N system has two or more (up to a maximum of six) modules of the same size (kVA). The load is equally divided between the units that form the system. The system can be of two types:

- Parallel power
  All the UPS's are able to provide the full power requested for the load.
- Parallel redundant
  The system comprises a higher number of UPS's able to provide the full power required for the load.
  For more detailed information on the operating principle of 1 + N parallel systems, refer to Operation Manual.

The 1+N system is used to:

- Increase the reliability of the system in order to ensure a good supply to the critical load connected.
- Increase the power availability (system expansion) in the event an unforeseen power demand occurs. This guarantees a greater flexibility in relation to the critical load connected.
- Increase serviceability and allow the execution of maintenance operations and reparations without affecting the ordinary operating conditions of the system (depending on the redundancy level).

The system can comprise of up to 6 UPS modules of the same power rating connected in parallel without the need for a centralized mains static bypass.
The following components are installed inside each UPS unit in the 1+N parallel system:
The parallel logic board, the parallel connector board and the corresponding flat connection cables.
From a '*power*' viewpoint each module is internally identical to the 'single module' configuration. A 1+N parallel system requires inverter and bypass supplies, inter-module control signals to manage current sharing, synchronizing and bypass switching between the modules. In figure 4-1 this is shown as the 'inter-module control bus', which is facilitated through the use of multi-way ribbon cables connected between the units of the system.
The number and length of these flat cables is determined by the positioning of the equipment in the system, so this supply is determined when the order is placed.

If the load is transferred onto a static bypass line, in a configuration in which three or more units are connected in parallel, there may be a problem dividing up currents on the power circuit. Each case is different, and depends on the length of the cables used, for example the resistance upstream and downstream of the static bypass line.
The differences between the impedances could result in undesirable division of currents over one or more UPS units. This problem may be solved by including an optional inductance on the static bypass line of each UPS unit.

Note: For each additional UPS unit, the operator control panel must be programmed with the correct size and the configuration of the static switch must be identified as 'internal'.

1 + N Configuration (>2 UPS's) or two UPS's with parallel power connection

IMPORTANT

(*) With configurations consisting of two UPS's with parallel power or 1+N systems integrated with more than two UPS's, where the load level is above the rated power of the single UPS, it is necessary to install an adequate external maintenance bypass. It is also necessary to adopt all the measures required to prevent the internal manual bypass switch of the UPS (Q3) from being used. This can be done by removing the handle of the switch and by placing a warning label for the maintenance personnel.

For information on the external maintenance bypass, see paragraph 4.4.

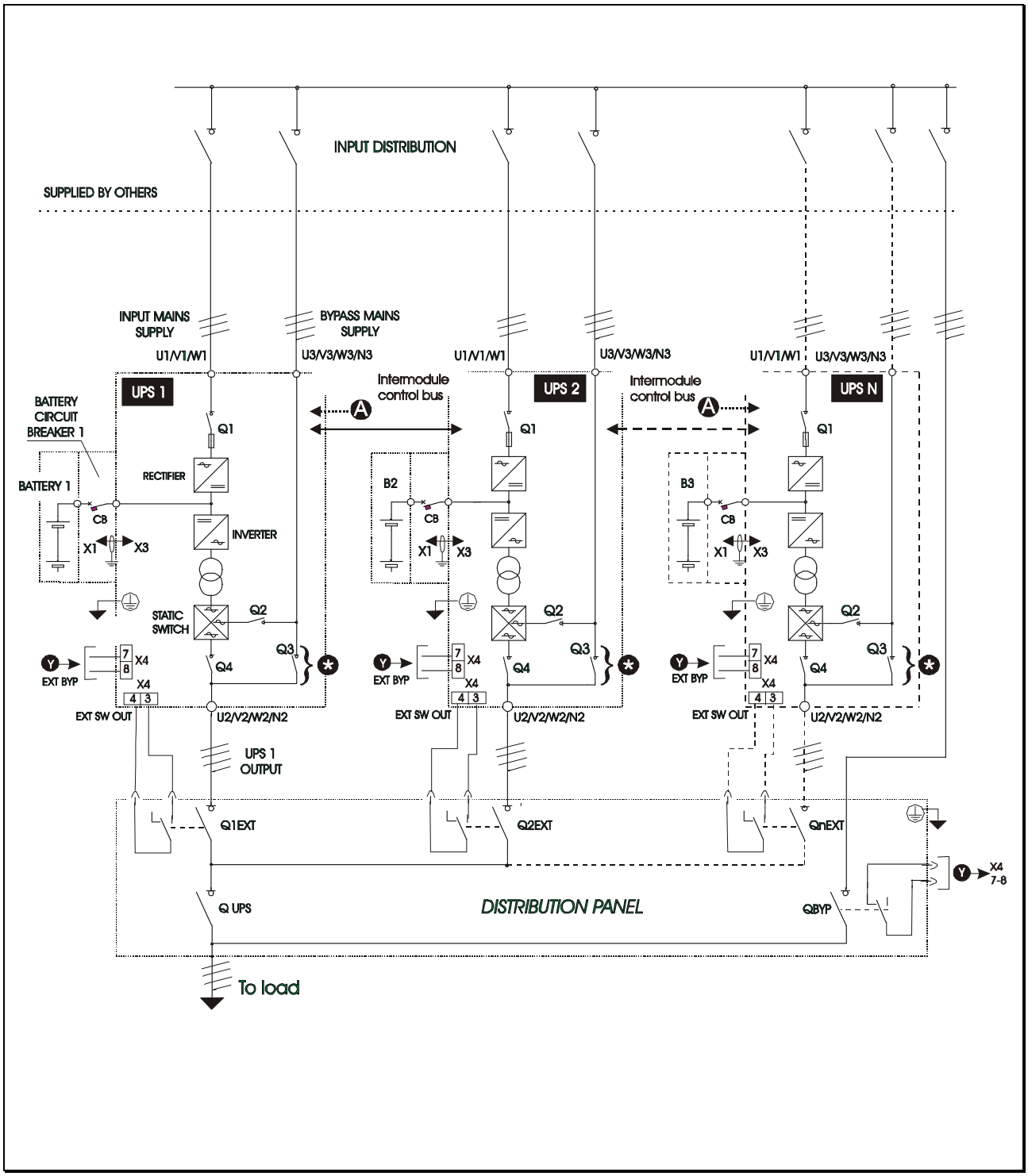


Figure 4-1 '1+N' System block diagram with separate batteries.

(*) See the warning message at the bottom of page 4-1.

4.2 Installation procedure

4.2.1 Preliminary Checks

Be sure that a parallel kit is present and fitted in each of the modules, and that the modules are of the same rating and with the same SW and HW release (See 'Operator Control & Display Panel' paragraph in the User Manual).

WARNING

Fitting of the parallel kits and board setting required to convert from Single Module to 1+N must be made by Liebert Service & Support trained personnel.

4.2.2 Protective Devices

Refer to the instructions supplied in Chapter 2 — Electrical Installation - Section 2.1.6.

4.2.3 Power cables

Input Bypass and Rectifier, outputs of modules
For power cabling the installation is the same for each module as described in Chapter 2.

4.2.4 Control cables

Inter-module control
Modules are interconnected as shown in Figure 4-2 using connections to the other UPS modules via the parallel connector board with shielded 34-way cables.
These cables are connected between the 'N' modules to pass control signals which govern module synchronization, load sharing, battery charge current sharing (in a common battery installation), load transfer operation and other general control and alarm functions. These signals are necessary to ensure correct system operation, and built-in redundancy allows the system to function if ever one of the 'N' cables becomes disconnected.

Inter-module Parallel Connections

1+N Parallel UPS System: Inside the module there is a parallel connection board (P/N 4590060U) mounted on the right hand side of the Static Switch cabinet. Connect one end of the interconnecting ribbon cable to interface connector (X1) of the first UPS module and the other end to connector (X2) of the second module, and so to the next module until a closed loop is formed.

Cable entry is as identified in the mechanical drawings in Chapter 6.

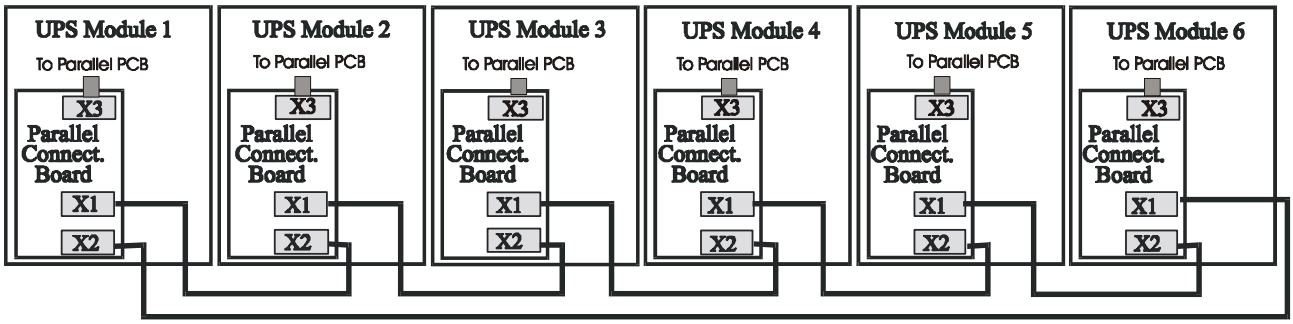


Figure 4-2 Connection of '1+N' system parallel signal bus cables

4.2.5 Battery Control

The system is designed to operate with two different battery configurations:

◊ **With separate batteries**

Installation procedure is the same as for single module.

◊ **With common battery (only for two units)**

In order that the battery charge current is shared equally between the modules, a 'common battery' option kit is available. (see Figure 4-6).

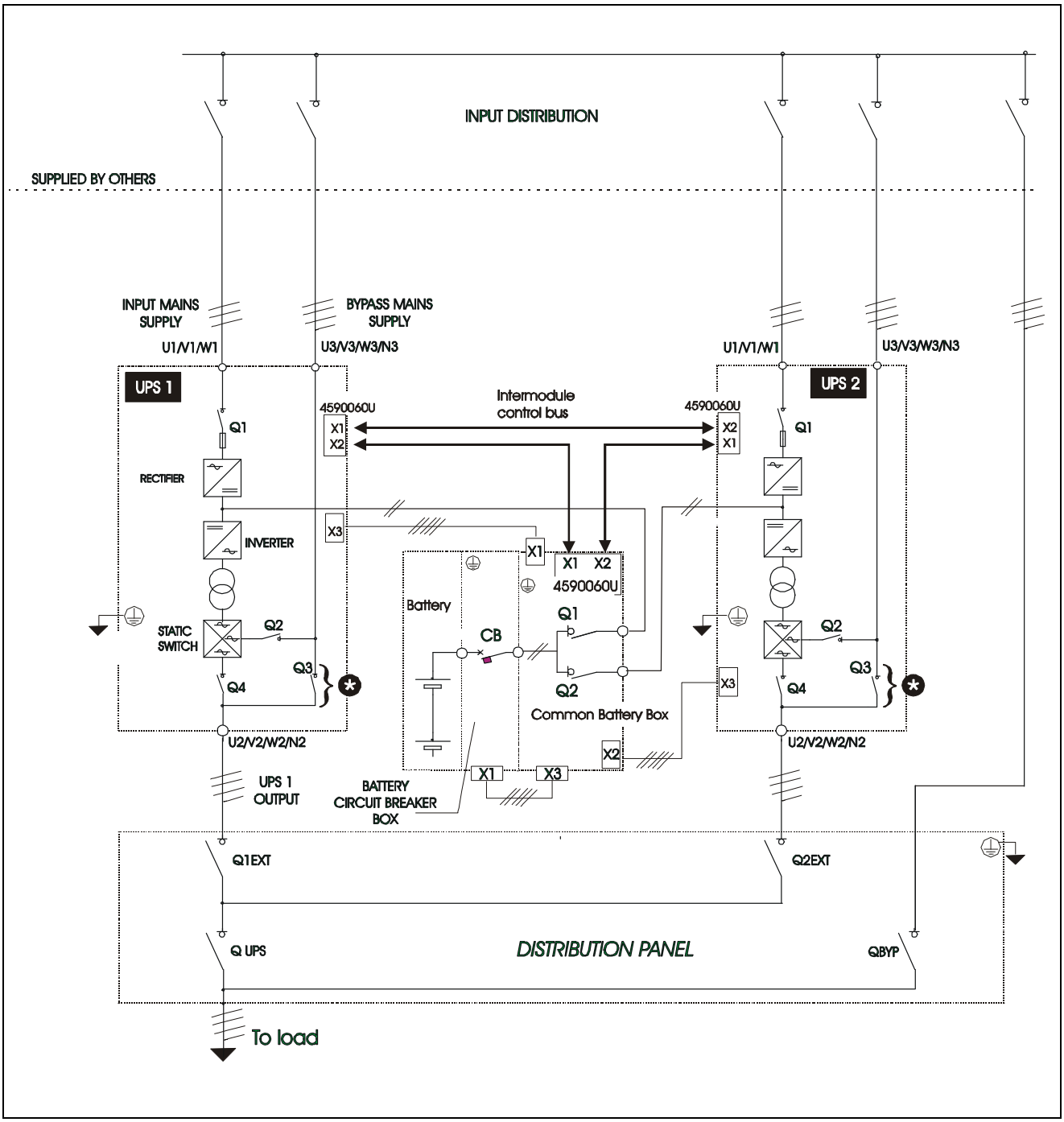


Figure 4-3 System with common battery

(*) See the warning message at the bottom of page 4-1.

4.2.6 Emergency Stop (EPO)

In a 1+N UPS System, each UPS module is provided of own emergency stop switch (EPO), as described in § 2.3.3.

If required, it is possible to coordinate the EPOs of each UPS module through an external emergency stop facility, using the auxiliary terminal block as indicate in the figure 4-4.

The recommended external EPO configuration should be made by qualified installation engineer who is familiar with local regulations and the equipment to be installed.

Note that this is a normally closed switch.

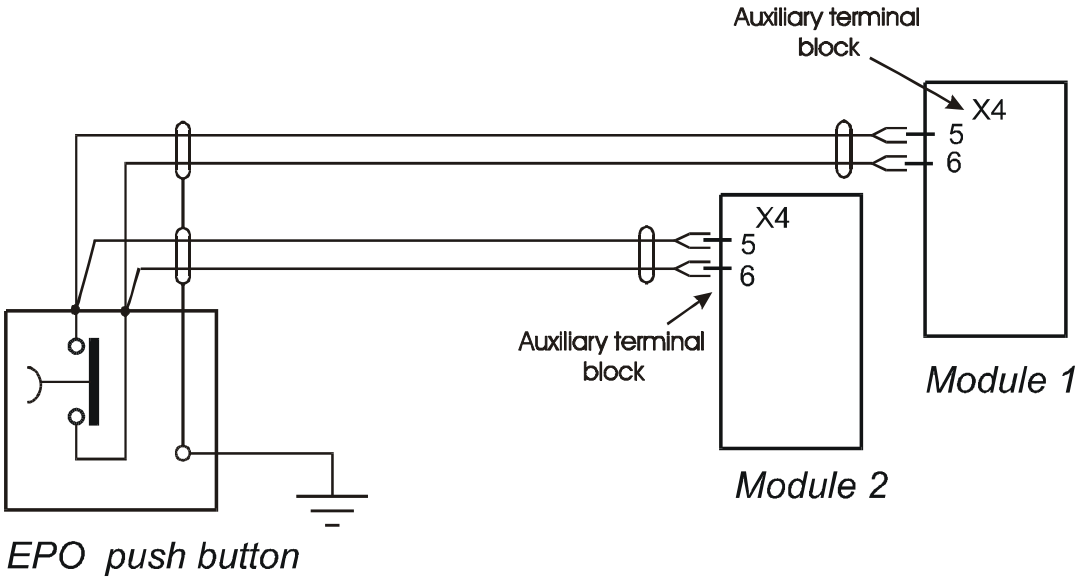


Figure 4-4 Connection of EPO push button.

The external push button must be located in a visible position which is easily accessible in the event of an emergency.

WARNING

The external Emergency Stop action shuts down the rectifier, inverter and static bypass sections and trips the battery circuit breakers. It does not however internally disconnect the inputs mains supplies. To complete shutdown the system follow the operative instructions in the User Manual. Always check with an AC/DC voltmeter to ensure safety before making contact or using tools.

4.3 Common battery box (Option)

4.3.1 Common Battery box for two UPS in parallel

A common battery box is available to permit a common battery to be shared between two modules (see fig.4-6). The box, which is used to connect the DC busbar of the two modules to a common battery, should be fitted as close as possible to the UPS modules, with cabling preferably of the same length.

Warning

There is no protection to prevent closing a module's battery isolation switch when its rectifier is shut down. Such operation will trip the battery circuit breaker and rupture the battery fuse in that module.

Before operating the module's battery isolation switch, the operator must first check that the battery voltage and rectifier voltage different by less than 10% — this may be easily achieved by reading the Battery Voltage on the Display Panels of both modules.

Control cable connections are required as shown in Fig. 4-5, this includes an extension of the inter-module cables described in Section 4.2.4. In addition there are other auxiliary connections that are identified in the figure below.

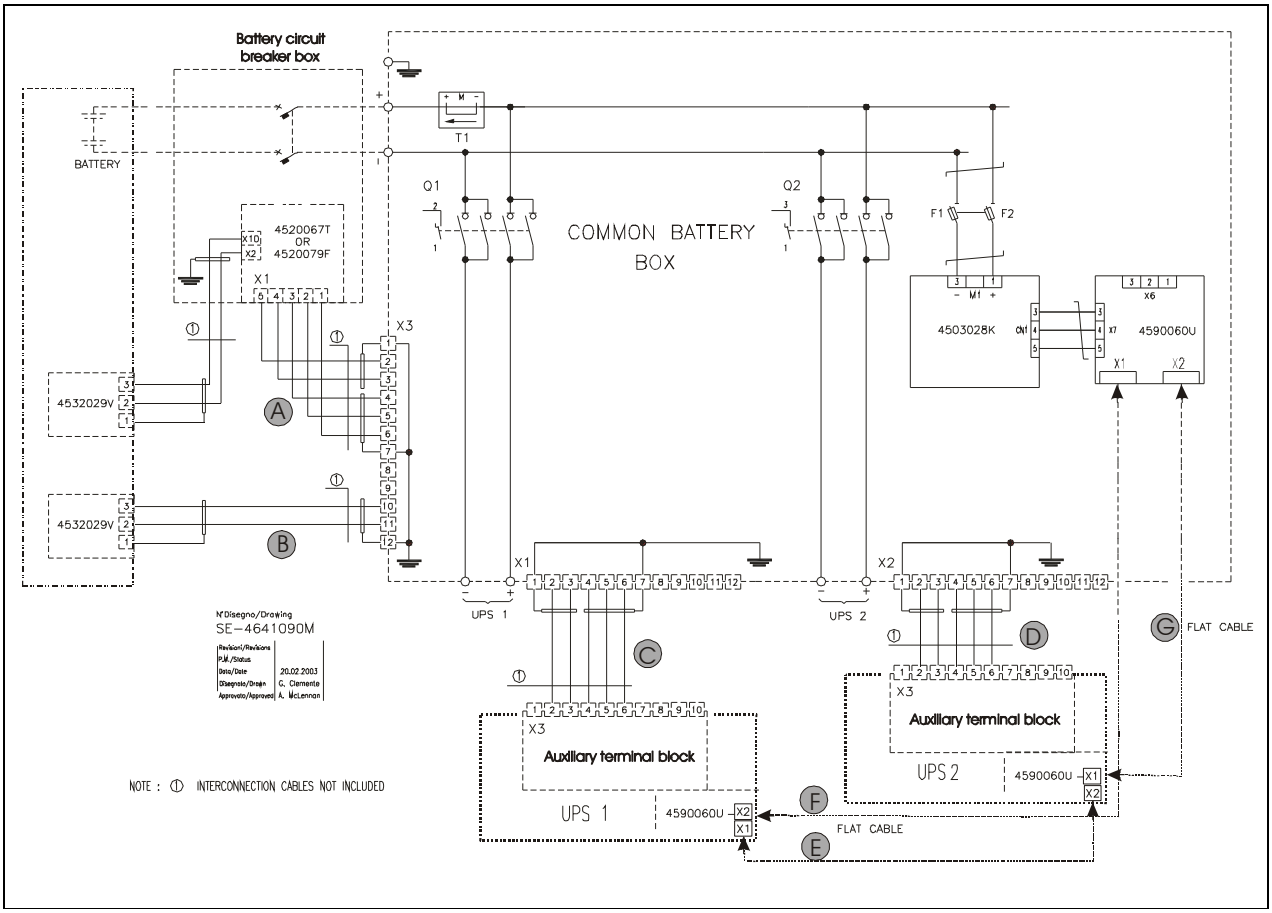
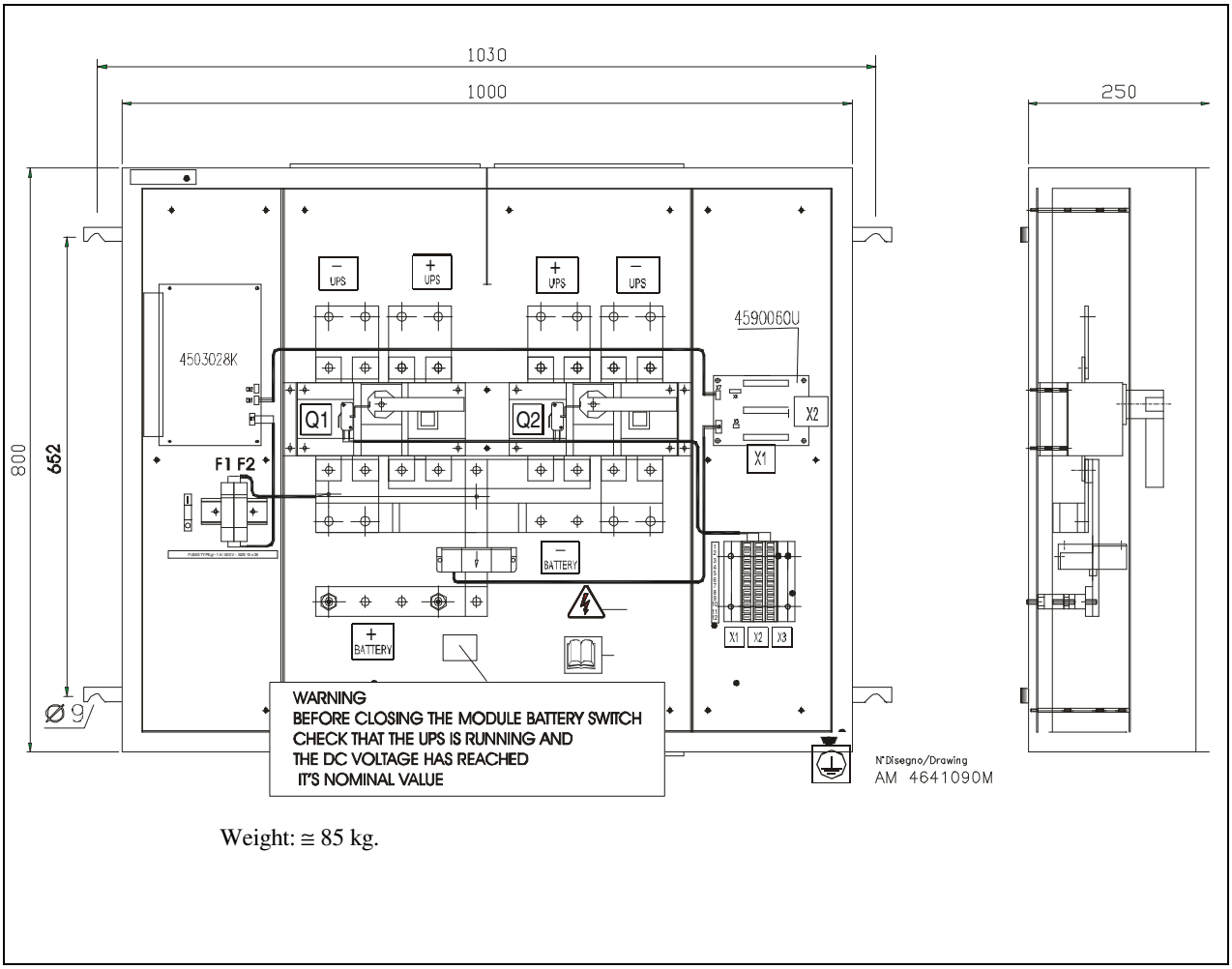


Figure 4-5 - Common Battery Box - connection details

Cable	
A	From common battery box (X3) to battery circuit breaker control board (X1) of BCB box
B	Auxiliary cables for battery sensor
C&D	Auxiliary cables from UPS terminal block to common battery box
F	From common battery box (X1) to parallel connectoring board (X2) of UPS**1** *(Ribbon cable)*
G	From common battery box (X2) to parallel connectoring board (X1) of UPS**2** *(Ribbon cable)*
E	Intermodule cables between parallel connectoring board (X1) of UPS**1** and parallel connectoring board (X2) of UPS**2** *(Ribbon cable)*



Weight: ≅ 85 kg.

Figure 4-6 Common battery box 800A (300 kVA Hipulse E)

4.3.1.1 Installation Procedure (Common Battery)

WARNING

If differential circuit breakers are used on UPS inputs, be sure to use a common device for all input lines. If the configuration has inputs from separate mains, a common device will also be required for all the System's bypass mains. At the instant of electrical connection, the current may not be split instantaneously and this may cause the residual current circuit-breakers to trip separately.

Refer to the general diagram shown in figure 4-3.

The 1+N parallel system with common batteries (only for two units) also uses the "Common Battery Box" optional kit (box type depends on UPS dimensions). This box uses two isolators to connect the battery to the two UPS modules, and thus individually isolate the two modules from the system.
The box is also designed to supply the two UPS modules with a battery current measurement (charge or discharge).
The Common Battery includes protection fuses of the DC power supply (F1&2):
Type GL = Size 10x38 – 1A\500V.

4.3.1.2 Connection between UPS and "Common battery box"

Refer to the diagram shown in figure 4-5 and the attached table.

1. POWER CABLES:
For the connection between the **UPS** modules and the **common battery box** use cables with the section indicated in the Installation Electrical (table 2-1).

2. AUXILIARY CABLES:
The auxiliary cables of the common battery box must be screened and double insulated.
The screen is connected to the earth of the common battery box.
Use multiple-core shielded cables with a section of 0.5 to 1 mm^2.
Connect the cables with the Fast-on 6.3x 0.8 mm terminals (female).

The temperature sensor, contained in a bag inside the Common Battery Box, must be mounted in the battery cabinet next to the sensor which was previously installed, and connected to the Common battery box through cable "B" as illustrated in figure 4-5.

Note: *Power and auxiliary cables are not included in the supply.*

4.4 Maintenance Bypass cabinet (Option)

Bypass cabinet enables maintenance operations and reparations to be performed in full isolation besides allowing the disabling of each UPS without affecting the ordinary operation of the system (depending on the redundancy level).
The optional maintenance bypass cabinet must be used in all configurations where the internal bypass is not sufficient to guarantee the power requested by the load.

This cabinet comprises:

- A cut-off isolator for the direct line, which disconnects the bypass line from the load
- Two isolators (see **Note 1**) to cut-off single UPS outputs
- A cut-off isolator for the output of the whole UPS system
- A terminal block for the auxiliary connections to the UPS's

Note (1): there are alternative solutions differing from suggested standard for specific installation requirements (i.e. with several UPS cut-off isolators).

Study the reference drawing provided in Chapter 6.

WARNING

Carefully follow the operating procedures provided in this manual to completely disable the UPS. It is useful to remember that all input/output power and battery switches must be open for the UPS to be completely insulated.

The UPS system with external maintenance bypass cabinet offers a standard protection that guarantees the blocking of the inverter and the switching of the load to the bypass line if the maintenance bypass switch is accidentally closed.

4.4.1 Auxiliary connections between the maintenance bypass cabinet and two UPS's

The maintenance bypass box connected to the terminal blocks requires specific control cabling, as described here below.

Maintenance Bypass cabinet		***UPS 2***	
X1-1	*Q2-N.O.*	*X4-3*	*EXT. SW. OUT*
X1-2	*Q2-COM*	*X4-4*	
		UPS 1	
X1-3	*Q1-N.O.*	*X4-3*	*EXT. SW. OUT*
X1-4	*Q1-COM*	*X4-4*	
X1-5	*Q3/4-N.C.*	*X4-7*	*EXT. BYP*
X1-6	*Q3/4-COM*	*X4-8*	
UPS 1		***UPS 2***	
X4-7	*EXT. BYP*	*X4-7*	*EXT. BYP*
X4-8		*X4-8*	

Table 4-1

Note: All auxiliary cables of terminal block X1 must be **double insulated**.
The cross-sectional area of the auxiliary cables is from 1 mm^2.
Connect the cables with the Fast-on 6.3x 0.8 mm terminals (female).
Power and auxiliary cables are not included in the supply.

4.4.2 Castell Interlock

The Castell Interlock enables the operator to close/open the external maintenance bypass switch following the procedure required to release/insert the key. The UPS Liebert Hipulse E system offers two types of Castell Interlock options: mechanical and electromechanical. The type must be selected depending on the configuration of the system installed in the plant.

Castell Interlock	
Configuration of the UPS system	***Type of Castell Interlock***
Two UPS's with parallel redundant connection (1+1)	*Mechanical Castell Interlock*
Two UPS's with parallel power or above two UPS's (1+N)	*Electromechanical Castell Interlock*

The Castell Interlock option is normally used in combination with the power isolators placed inside the external maintenance bypass cabinet.

Note: The Liebert Hipulse E UPS system is already pre-arranged for the installation of this option.

This option comprises:

- A Castell Interlock with key (BP1) for each UPS of the system. The key is normally blocked and released only when the UPS inverter turns off and the load is switched to the static bypass, depending on the active UPS modules.
- A Castell key exchange box. This will receive the keys from all the UPS modules, then release another key (BP2) to use in the Maintenance Bypass isolator.
- A Castell Interlock with key (BP2), situated on the external maintenance bypass isolator. As this isolator is normally open and has no key, it can be closed only with the key (BP2) released by the Castell key exchange box. The key is released only when the isolator is open.
- A Castell Interlock with key (BP2), situated on the UPS output isolator within the external maintenance bypass cabinet. This isolator is normally closed and has a key. The key is released only when the isolator is open.

4.4.2.1 Electromechanical Castell Interlock

This option consists of a Castell key exchange box and of several Castell units with individual key. Their number varies according to the number of UPS's present in the system.
The release of a specific key (BP1) occurs only when the inverter turns off. As a consequence thereof, the load is transferred to the internal static bypass line (the switching operation occurs when the number of active UPS's is lower that the number set in the menu of the operator control panel). The key, which is fixed in position by means of an electromechanical device, can only be removed by pressing the energising button of the solenoid and when the green indicator is on. The keys extracted from the UPS's (n BP1) enable to free a second key (BP2) from the Castell key exchange box and to close the external maintenance bypass isolator, enabling the line that directly connects the bypass mains to the load. To isolate the UPS system, it is necessary to open the UPS output isolator of the external bypass cabinet, the protective devices at the input distribution panel and the battery circuit breaker. At this point, the load is supplied by the direct line inside the maintenance bypass cabinet and it is possible to perform maintenance operations or reparations on the UPS as it is completely isolated.

4.4.2.2 Mechanical Castell Interlock

The description above is valid also for this type of Castell unit, with the following exceptions:

- The maintenance bypass switch (Q3) of the UPS is closed before the external bypass isolator.
- The key (BP1) acts on the maintenance bypass isolator (Q3) blocking (or disengaging) a mechanical stop.
- No button needs to be pressed to extract the key (BP1) on the UPS.

The keys symbols of the Castell Interlocks can be customized to suit the needs of the customer.

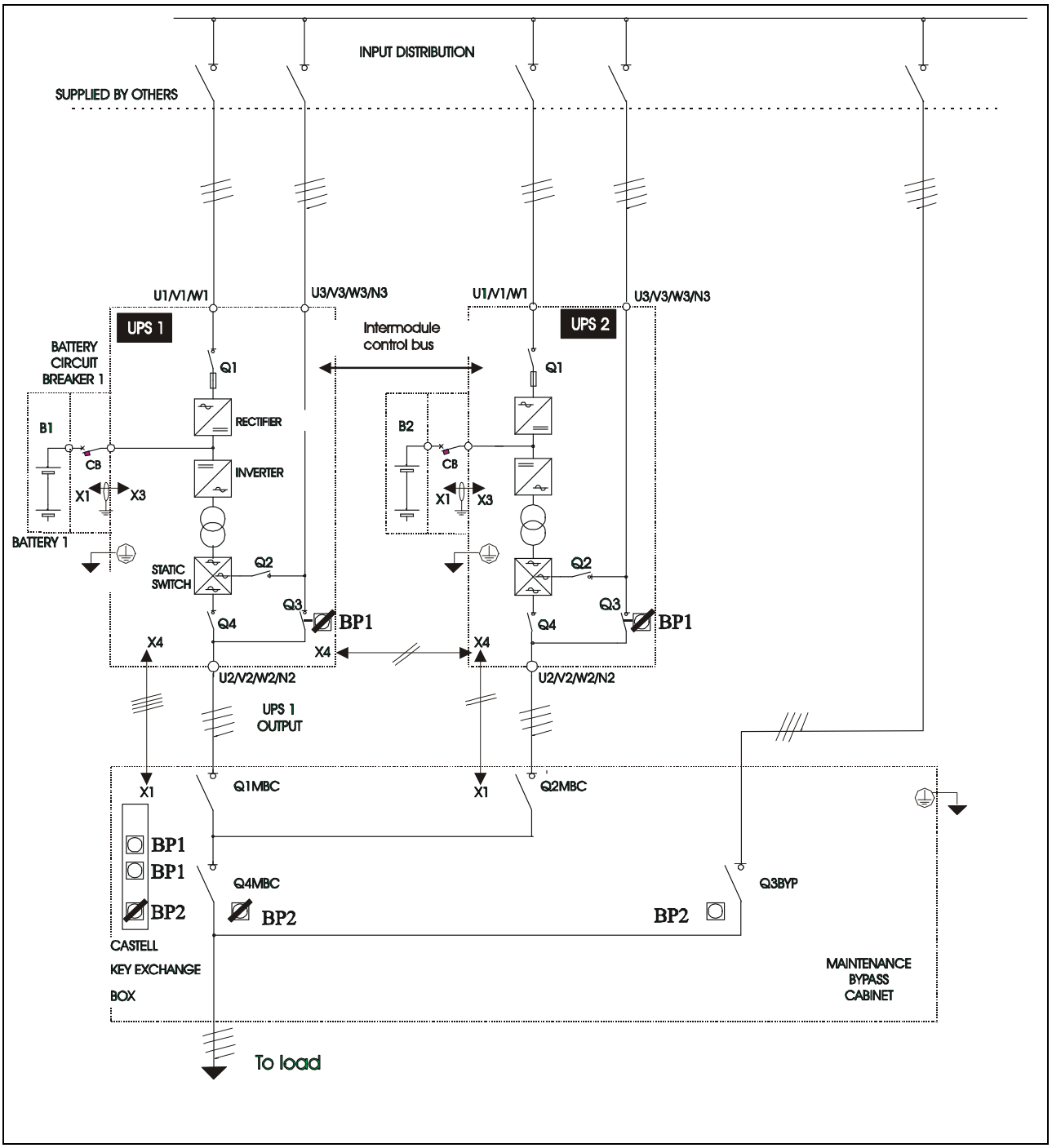


Figure 4-7 Example of configuration with two redundant UPS's connected in parallel with the external maintenance bypass cabinet.

This drawing should show an external maintenance bypass supply for the system (with two redundant UPS's) as referred to in the warning message at the bottom of page 4-1.

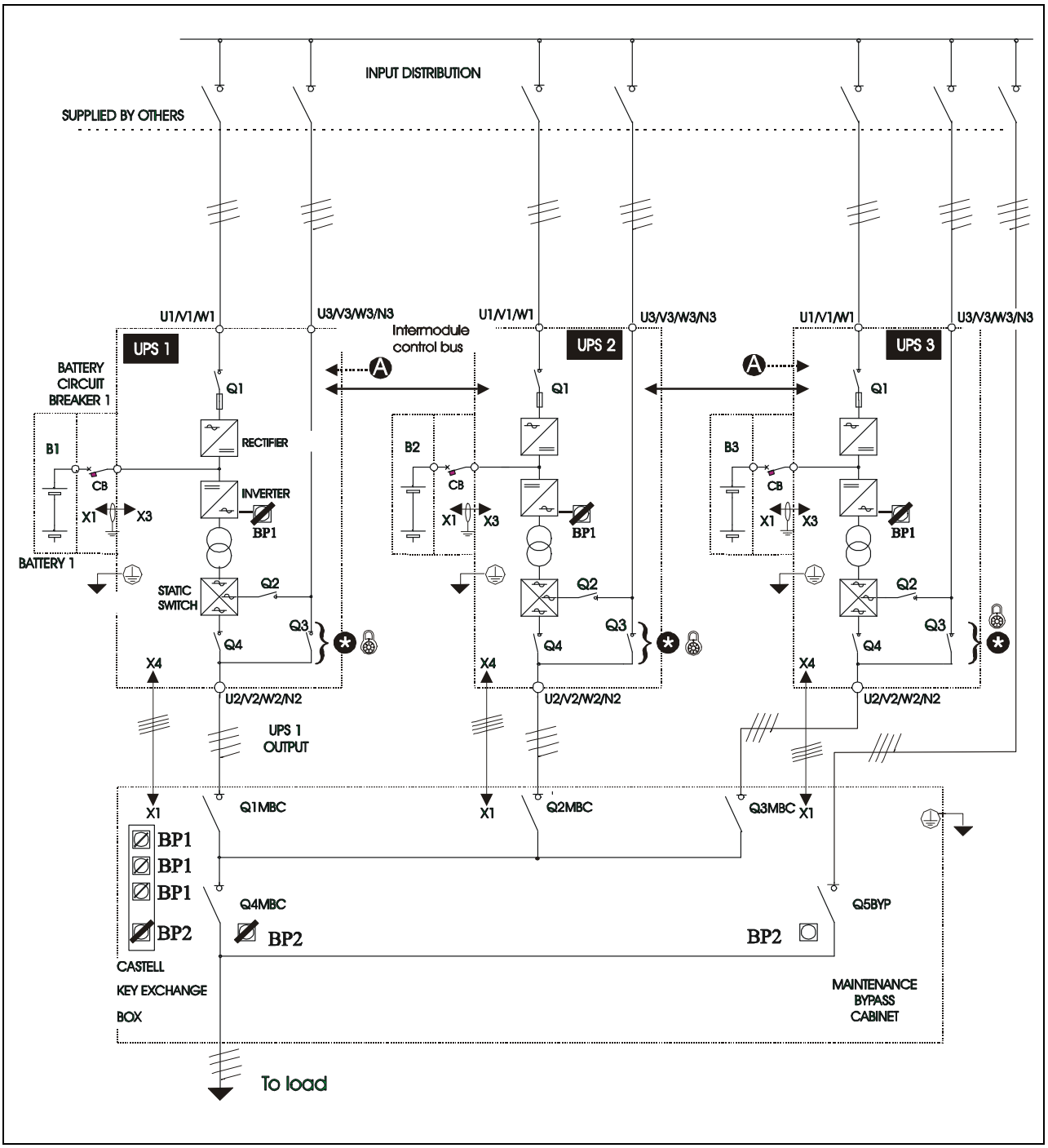


Figure 4-8 Example of configuration with three UPS's connected in parallel with the external maintenance bypass cabinet.

This drawing should show an external maintenance bypass supply for the system (with three UPS's) as referred to in the warning message at the bottom of page 4-1.

5 Chapter 5 - Specification

This specification describe requirements for an Uninterruptible Power System (UPS).

5.1 Conformity and Standard

The UPS has been designed to conform to the following standards:

Description	Year	Normative references
General and safety requirements for UPS used in operator access areas	2002	EN 62040-1-1 IEC 62040-1-1
Emissions requirements	1995	EN 50091-2 — (tables 2 and 4)*
Method of specifying the performance and test requirements	2001	EN 62040-3 identical to IEC 62040-3 (1999)
* Class 'A' compliance if optional RFI filters is fitted (only for 300 kVA UPS)		
CE marked		

The above mentioned product standards incorporate relevant compliance clauses with generic IEC and EN standards for safety (60950) and construction (60529).
For more details, see below:

Description	Year	Normative references
Information technology equipment	2000	EN 60950
Degrees of protection provided by enclosures (IP code).	1989	EN 60529

5.2 UPS Environmental

The UPS shall be able to operate under the following environmental conditions without damage or degradation in electrical operating characteristics:

ENVIRONMENTAL CHARACTERISTICS	UNITS		
Rated power	**kVA**	**300**	**400**
Operating Temperature	°C	0- 40	
Maximal temperature for 8 hr day	°C	40°C de-rate power by 1,5% per °C between +40°C and + 50°C	
Mean Temperature for 24 h	°C	35	
Relative humidity	—	≤ 90% at 20°C	
Acoustical noise	dBA	70	73
Altitude of operation		≤1000m asl de-rate power by 1% per 100m between 1000 and 2000 m	
Storage-Transport Temperature	°C	-25 ÷ 70	

5.3 UPS Mechanical Characteristics

MECHANICAL CHARACTERISTICS	UNITS	UPS							
		300 kVA (6 pulse)	300 kVA (12 pulse)		400 kVA (6 pulse)		400 kVA (12 pulse)	
Section			**UPS**	**12 pulse**	**Rect./St.**	**Inverter**	**Rect./St**	**Inverter**
Height	mm	1900						
Width of each section		1640	1640	640	1230		1230	
Total width		1640	2280		2460			
Total width including top cable entry option		2280	2920		3100			
Depth		856						
Weight of each section	kg	1850	1810	730	640	1750	1310	1750
Total weight without Input Filter			2540		2390		3060	
Total weight with Input Filter								
" " " (filter 4%)			2650				3192	
" " " (filter 9%)		2010			2574			
Ventilation	-	By internal extract fans						
Airflow	m^3/h	4500	5000		8000			
Cable entry	-	From bottom or from top with optional TCE or both sides through *optional* kick plates						
Colour (See Note 2)	-	RAL 7035 (Light grey) or RAL 7021 (Black Grey)						
Protection level (with open/closed front doors)		IP 20						

Note: Dimensions and weight do not include the pallet and packing material. Actual weight will vary depending on installed options.
Note 2: The RAL colour can be selected through digit model number in the Configurator when place the order.

OPTION		
MAINTENANCE BYPASS CABINET *1+ 1 Configuration (two UPS's with parallel redundant connection)*		
Height	mm	1900
Width		900
Depth		856
Weight	kg	300
Cable entry	-	Top and bottom or both sides (by *optional* kick plates)
Colour (See Note 2)	-	RAL 7035 (Light grey) or RAL 7021 (Black Grey)
Protection grade	-	IP 20
Power isolators		SIRCO 4 poles 630A (at 400 Vca)

5.4 UPS Electrical Characteristics (Input Rectifier)

RECTIFIER INPUT MAINS					
	UNITS				
Rated power	**kVA**	**300 (6 pulse)**	**300 (12 pulse)**	**400 (6 pulse)**	**400 (12 pulse)**
Rated mains voltage ❶	Vac	380 - **400** - 415 V			
Supply		Three phase without neutral			
Input voltage tolerance ❷	%	-15, +10			
Frequency	Hz	**50** / 60			
Input frequency tolerance	%	± 5			
Rated input power ❸	kVA	321	304	431	410
with input harmonic filter		276 with Input Filter (9%)	304 with Input Filter (4%)	371 with Input Filter (9%)	410 with Input Filter (4%)
Rated input current ❸	A	463	438	622	591
with input harmonic filter		399 with Input Filter (9%)	439 with Input Filter (4%)	535 with Input Filter (9%)	591 with Input Filter (4%)
Maximal input power ❹	kVA	405	384	540	520
with input harmonic filter		345 with Input Filter (9%)	384 with Input Filter (4%)	463 with Input Filter (9%)	520 with Input Filter (4%)
Maximal input current ❹	A	600	554	800	751
with input harmonic filter		499 with Input Filter (9%)	554 with Input Filter (4%)	669 with Input Filter (9%)	751 with Input Filter (4%)
Duration of progressive power walk-in ❺	sec	2 or 10			
Maximal output current	A	750		1000	

The input current and power values are referred to PF 0.8. Refer to Marketing Technical Specification for option XTreme PF 0.9 and 1.0.

Note:

❶= 380V or 415V set changing taps on auxiliary supply transformer.

❷= With mains at –15% and suggested battery elements the UPS maintains the output rated voltage at rated load but cannot guarantee float charge to battery; the battery does not discharge.

❸= EN 62040-3 (3.4.5): UPS , rated load, input rated voltage 400V, no current to battery.

❹= EN 62040-3 (3.4.6): UPS , rated load or overload, input rated voltage 400V, battery on boost charge with maximal allowed current.

❺= Set with jumper on Rectifier Control Board (slow or fast).

5.5 UPS Electrical Characteristics (DC Intermediate Circuit)

DC INTERMEDIATE CIRCUIT			
	UNITS		
Rated power	**kVA**	**300**	**400**
Voltage range for inverter operation	Vdc	320 – 490	
Recommended number of lead-acid cells ❶-❷	No	192 (380Va.c.) **198 (400Va.c.)** ❻ 204 (415Va.c.)	
Recommended float charge voltage 2.25 V/el. ❶	Vdc	432 (380Va.c.) **446 (400Va.c.)** 459 (415Va.c.)	
Recommended boost charge voltage 2.40 V/el. ❶	Vdc	460 (380Va.c.) **475 (400Va.c.)** 490 (415Va.c.)	
Recommended end of discharge voltage 1.67 V/el. ❶	Vdc	320 (380Va.c.) **330 (400Va.c.)** 340 (415Va.c.)	
Recommended test voltage 1.90 V/el. ❶	Vdc	365 (380Va.c.) **376 (400Va.c.)** 388 (415Va.c.)	
Maximum voltage on manual charge 2.45 V/el. ❶	Vdc	480 (380Va.c.) **495 (400Va.c.)** 500 (415Va.c.)	
Maximum recharge battery current	A	150	200
Battery boost charge cycle ❸	-	Characteristics to DIN 41772 I-U, boost to floating charge switching, with current measuring criterion plus control of charging time	
Maximum boost charge duration ❸	min	0-999	
Boost-float threshold current ❸	A	0-99	
Temperature voltage compensation ❹	mV/°C	2	
Ripple voltage superimposed ❺	%	≤1	

Note:

❶= (According to rated voltage).

❷= Factory set for rated 400 V, different cells number and voltage per cell may be set by software and/or trimmers on Rectifier Control Board.

❸= Set by software.

❹= With external temperature sensor, feature selected on Rectifier Control Board.

❺= Battery disconnected, RMS percentage value referred to DC voltage.

❻= Lead acid (SMF/VRLA and WET cell) and Ni-Cad with constant voltage and current charging for European units.

5.6 UPS Electrical Characteristics (Inverter Output)

INVERTER OUTPUT			
	UNITS		
Rated power	**kVA**	**300**	**400**
Rated mains voltage ❶	Vac	380 - **400** - 415	
Supply		Three phase with neutral	
Frequency ❷	Hz	**50** / 60	
Rated Power at cos φ = 0.8	kVA	300	400
Rated Power at cos φ = 1	kW	240	320
Three -phase transient overload ❸	%	110 for 60 minutes 125 for 10 minutes 150 for 1 minute	
Single -phase transient overload	sec I/In	30 2.2	
Maximal non linear load allowed ❹		100% Pn	
Voltage stability, steady state test ❺	%	± 1	
Voltage stability, transient test ❻	%	± 5	
Maximum rate of change of frequency ❼	Hz/sec	0.1	
Current rating of neutral cable ❽	A	630 (1) 945 (2)	

Note:

❶= Factory set 400V — 380 or 415 voltages with software setting.

❷= Factory set at 50Hz; 60 Hz with software setting.

❸= EN 62040-3 (3.5.8).

❹= EN 62040-3 (3.4.14 and annex E) crest factor 3.

❺= EN 62040-3 (6.3.4).

❻= EN 62040-3 (6.3.7) also for 0-100-0%, load transient, restore time 20 ms to ±1%.

❼= Factory set at 0.1Hz/sec; 0.5 to 1 Hz/sec with software setting for UPS single module.

❽= (1) refers to the sizing of the UPS power isolators (cut-off neutral).
(2) optional kit to uprate the neutral cut-off current rating where local regulations permit.

5.7 UPS Electrical Characteristics (Bypass Input Mains)

BYPASS INPUT										
	UNITS									
Rated power	**kVA**	**300**				**400**				
Rated mains voltage❶	Vac	380 - **400** - 415 V								
Supply		Three phase with neutral								
Rated Current:										
380Vac	A	470				627				
400Vac		446				595				
415Vac		430				574				
		(*) load assumed @ P.F. = 0.8								
Bypass voltage tolerance ❷	%	± 10								
Delay time to recognise bypass voltage returned to window	sec	10								
Inverter output voltage window	%	± 10								
Frequency ❸	Hz	**50** \ 60								
Input frequency tolerance ❹	%	± 2								
Maximum frequency slew rate	Hz/sec	0.1								
Current rating of neutral cable ❺		630 (1) 945 (2)								
Protection, bypass line		To avoid series fuses, the bypass line should be protected using an external device in the input distribution system. This device should be sized to discriminate with the load protection.								
Transient overload	ms I/In	10 14.3	20 12.6	50 11.0	100 10.0	200 9.0	500 8.0	1000 7.1	2000 6.6	5000 5.7

Note:

❶= Factory set 400V — 380 or 415 set changing taps on auxiliary supply transformer and with software setting.

❷= Other values 0 –15% with software setting.

❸= Factory set at 50Hz; 60 Hz with software setting.

❹= Other values 1 – 9 % with software setting.

❺= (1) refers to the sizing of the UPS power isolators (cut-off neutral).
(2) optional kit to uprate the neutral cut-off current rating where local regulations permit.

5.8 Typical UPS losses

The typical UPS losses values are referred at input rated voltage 400V and PF 0.8.
Refer to Marketing Technical Specification for option XTreme PF 0.9 and 1.0.

LOSSES					
Rated power	**UNITS kVA**	**300 (6 pulse)**	**300 (12 pulse)**	**400 (6 pulse)**	**400 (12 pulse)**
Full load losses (100%)	kW	16.4	18.1	24.1	27.4
with input harmonic filter		16.79 with Input Filter (9%)	18.9 with Input Filter (4%)	24.8 with Input Filter (9%)	26.7 with Input Filter (4%)
ECOMODE		7.4	8.0	9.9	10.3

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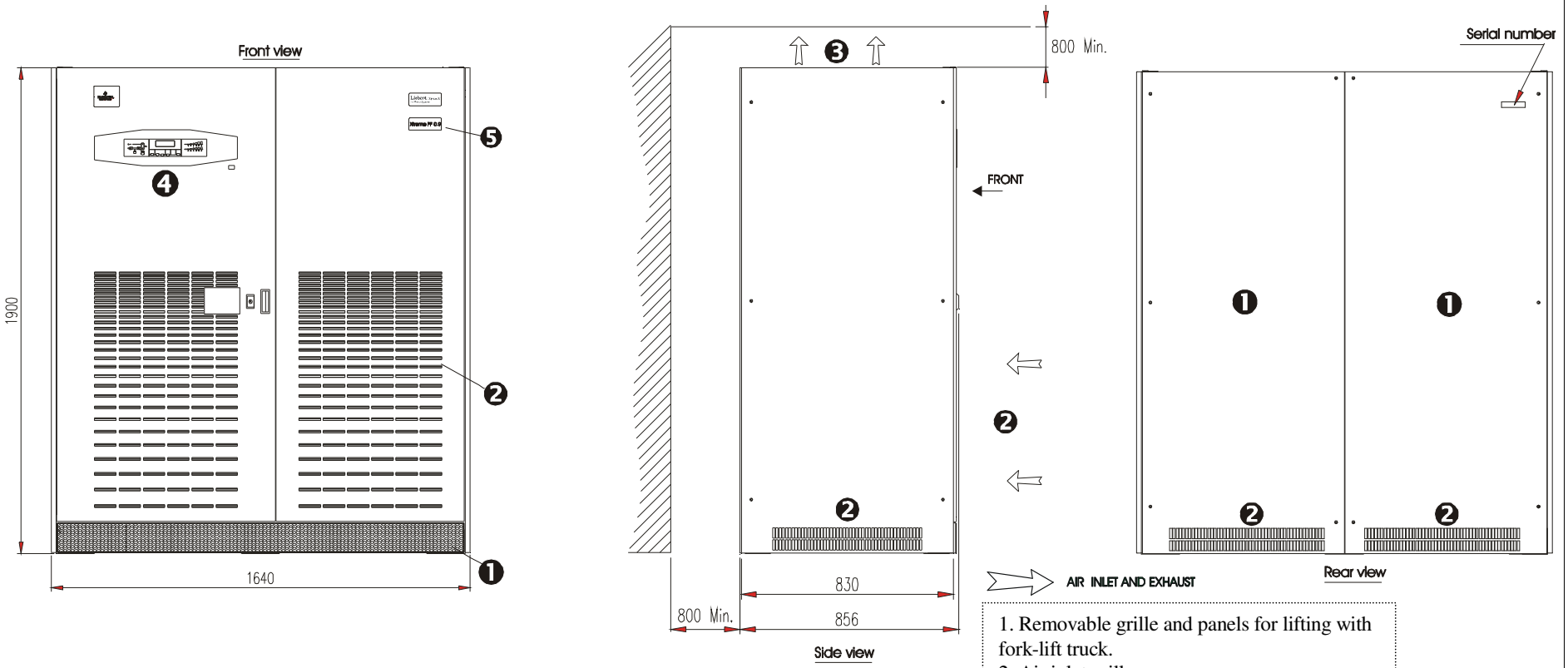
6 Chapter 6 - Installation Drawings

6.1 Introduction

The drawings below illustrate the principal mechanical and electrical characteristics of the Liebert Hipulse E and of its various optional cabinets.

In these drawings you will find all information of use for positioning the equipment, determining cable entry, making electrical power and auxiliary connections, determining the position of isolators, determining the physical location of various optional equipment, etc.

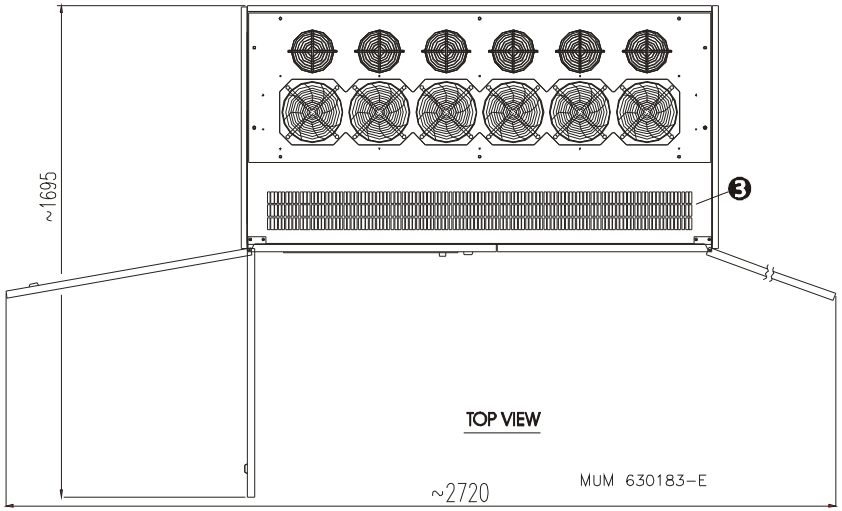
6.1.1 300kVA UPS Module with 6 pulse rectifier

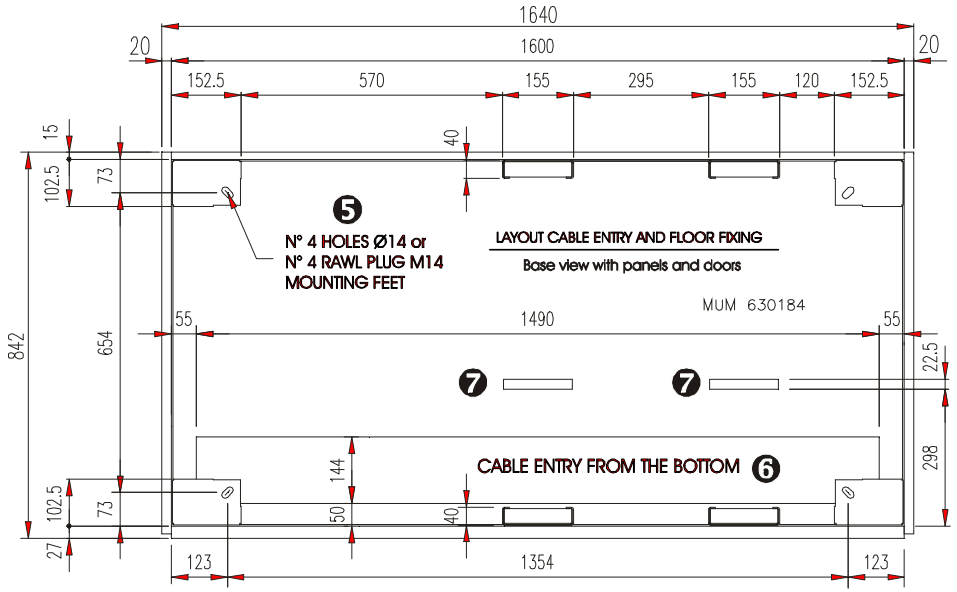


1. Removable grille and panels for lifting with fork-lift truck.
2. Air inlet grille
3. Air exhaust
- 800 mm min. clearance above unit required for air exhaust.
4. Operator control and display panel
5. XTreme label (with option fitted only)

All dimensions are in mm.

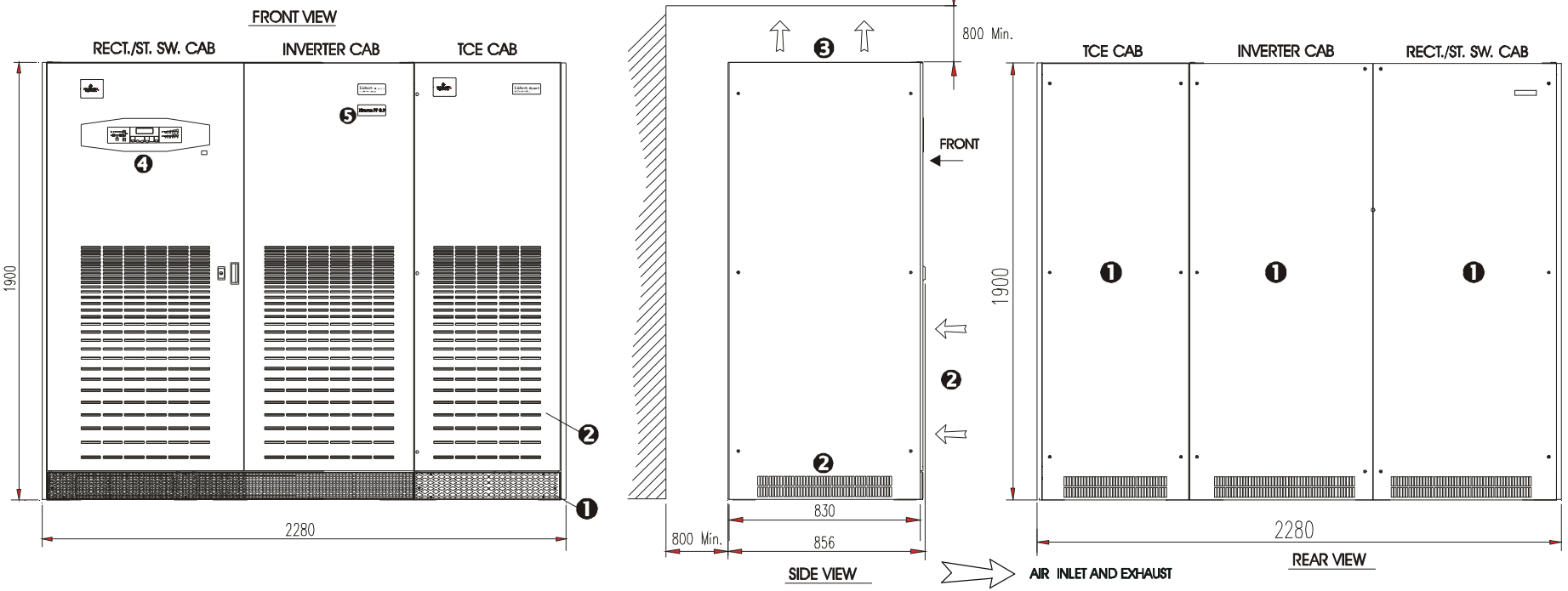
6.1.2 300kVA UPS Module with 6 pulse rectifier – Top and base view





Layout cable entry and floor fixing
Base view with panels and doors
5. N°4 holes ∅ 14 for securing unit to floor (if required)
- N° 4 rawl plug M14 -
- Mounting feet
6. Bottom cable entry
7. Load supporting feet
All dimensions are in mm.

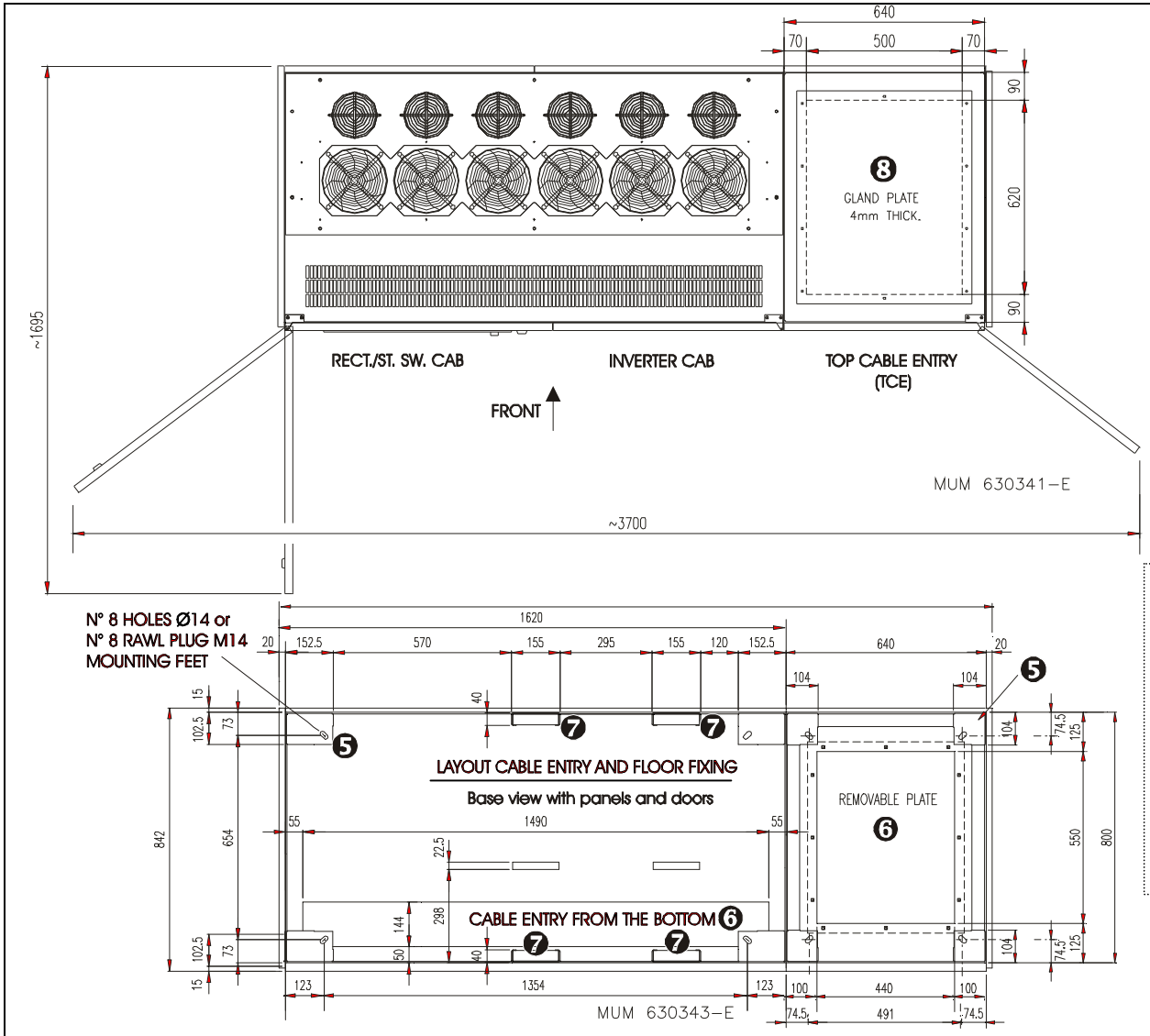
6.1.3 300kVA UPS Module with 6 pulse rectifier with Top Cable entry option



1. Removable grille and panels for lifting with fork-lift truck.
2. Air inlet grille
3. Air exhaust
- 800 mm min. clearance above unit required for air exhaust.
4. Operator control and display panel
5. XTreme label (with option fitted only)

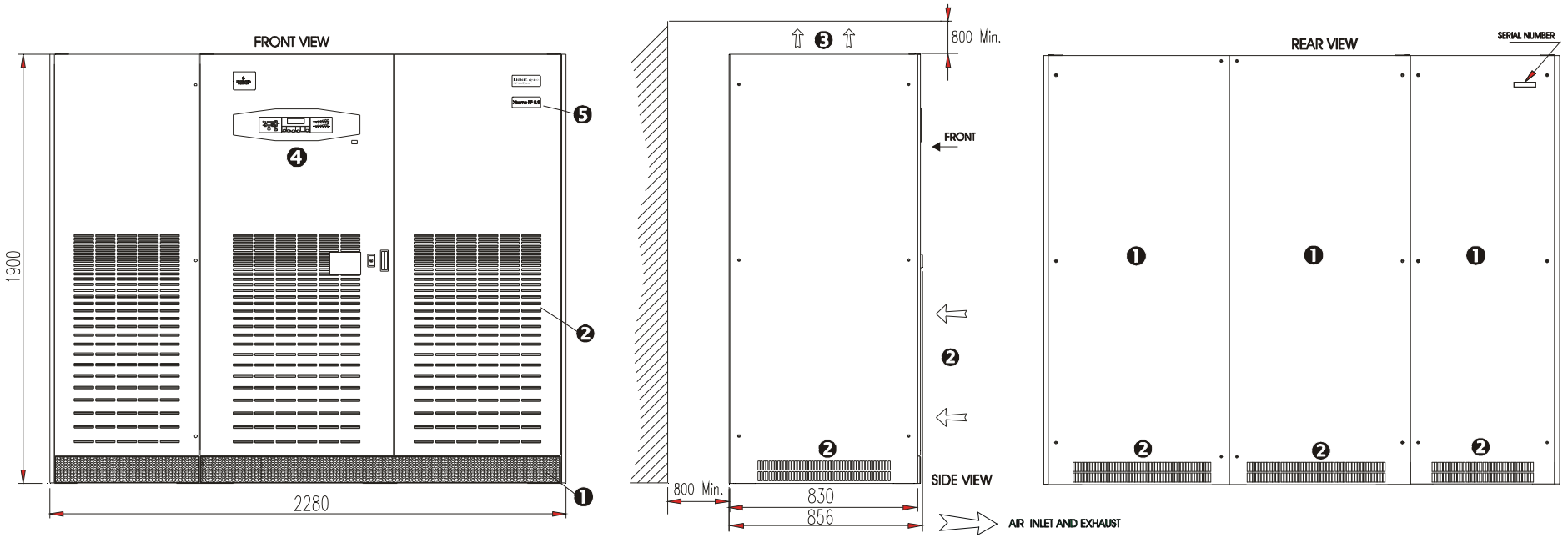
All dimensions are in mm.

6.1.4 300kVA UPS Module with 6 pulse rectifier with Top Cable entry option – Top and base view



Layout cable entry and floor fixing
Base view with panels and doors
5. N°8 holes ∅ 14 for securing unit to floor (if required)
- N° 8 rawl plug M14 -
- Mounting feet
6. Bottom cable entry
7. Load supporting feet
8. Top cable entry (user to size and cut holes for the cables to be used)
All dimensions are in mm.

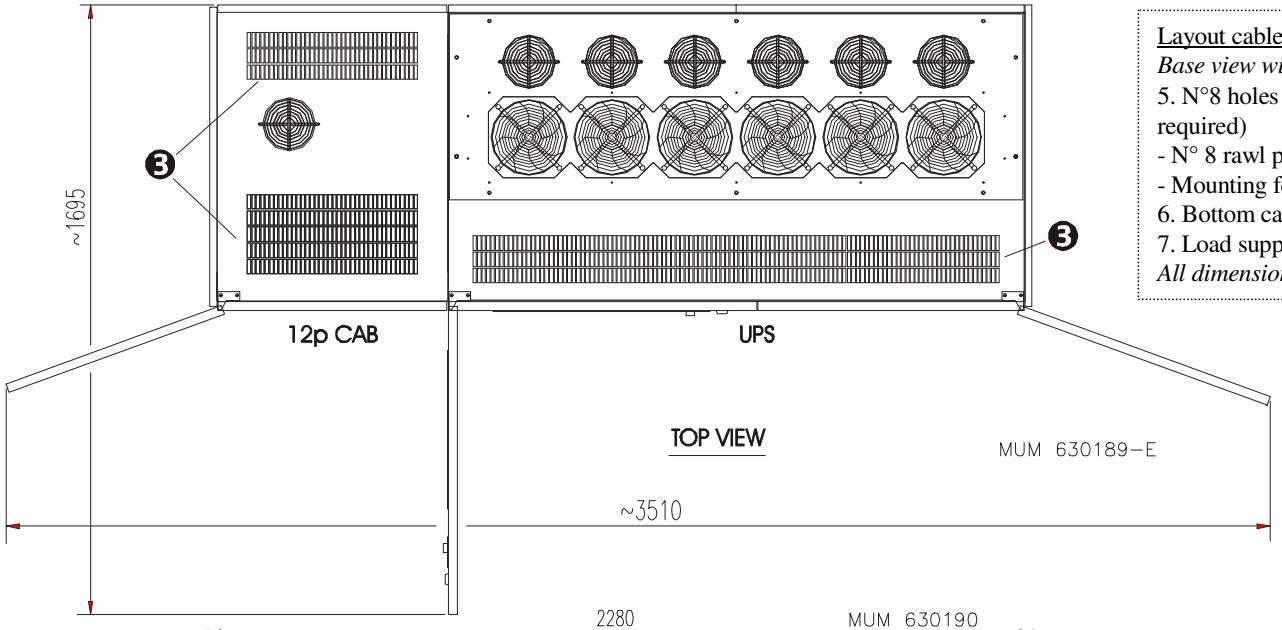
6.1.5 300kVA UPS Module with 12 pulse rectifier

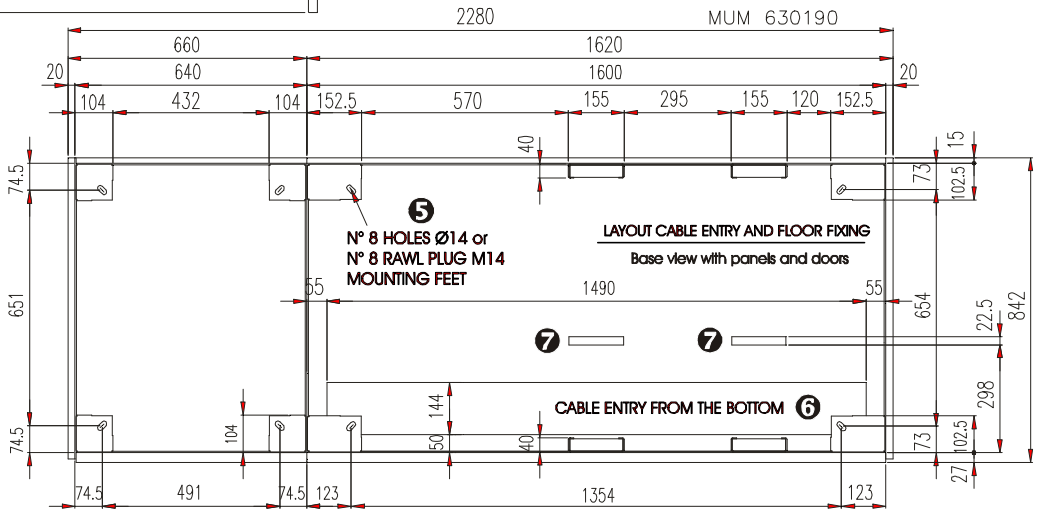


1. Removable grille and panels for lifting with fork-lift truck.
2. Air inlet grille
3. Air exhaust
- 800 mm min. clearance above unit required for air exhaust.
4. Operator control and display panel
5. XTreme label (with option fitted only)

All dimensions are in mm.

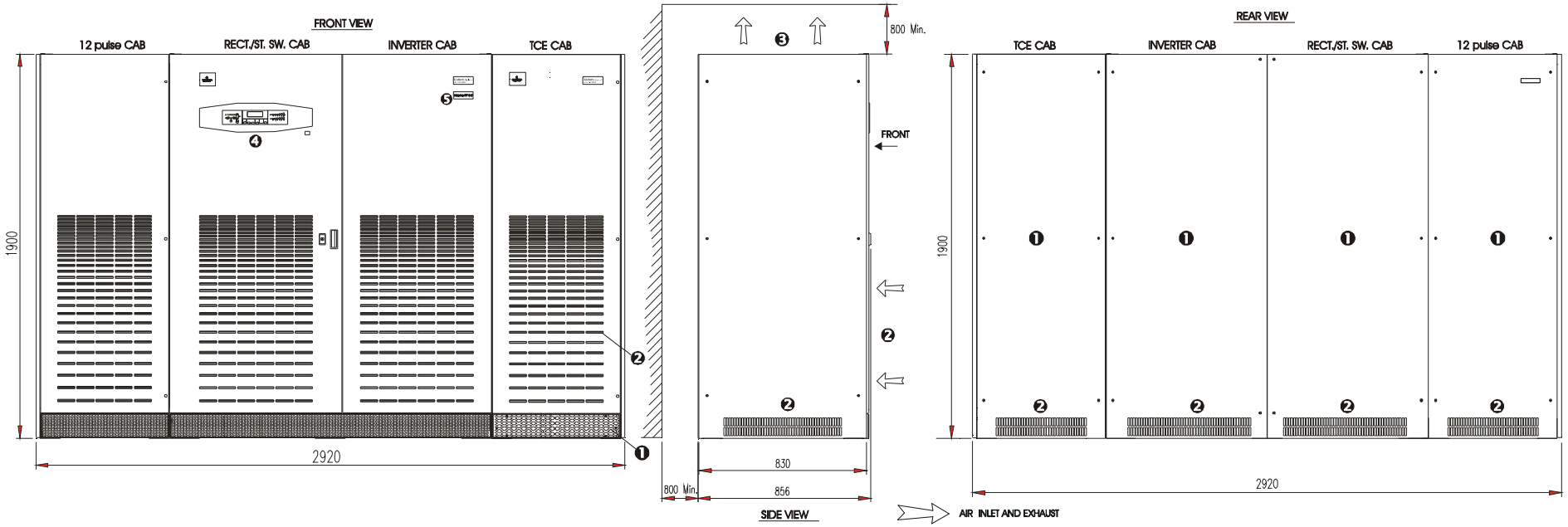
6.1.6 300kVA UPS Module with 12 pulse rectifier – Top and base view





Layout cable entry and floor fixing
Base view with panels and doors
5. N°8 holes ∅ 14 for securing unit to floor (if required)
- N° 8 rawl plug M14 -
- Mounting feet
6. Bottom cable entry
7. Load supporting feet
All dimensions are in mm.

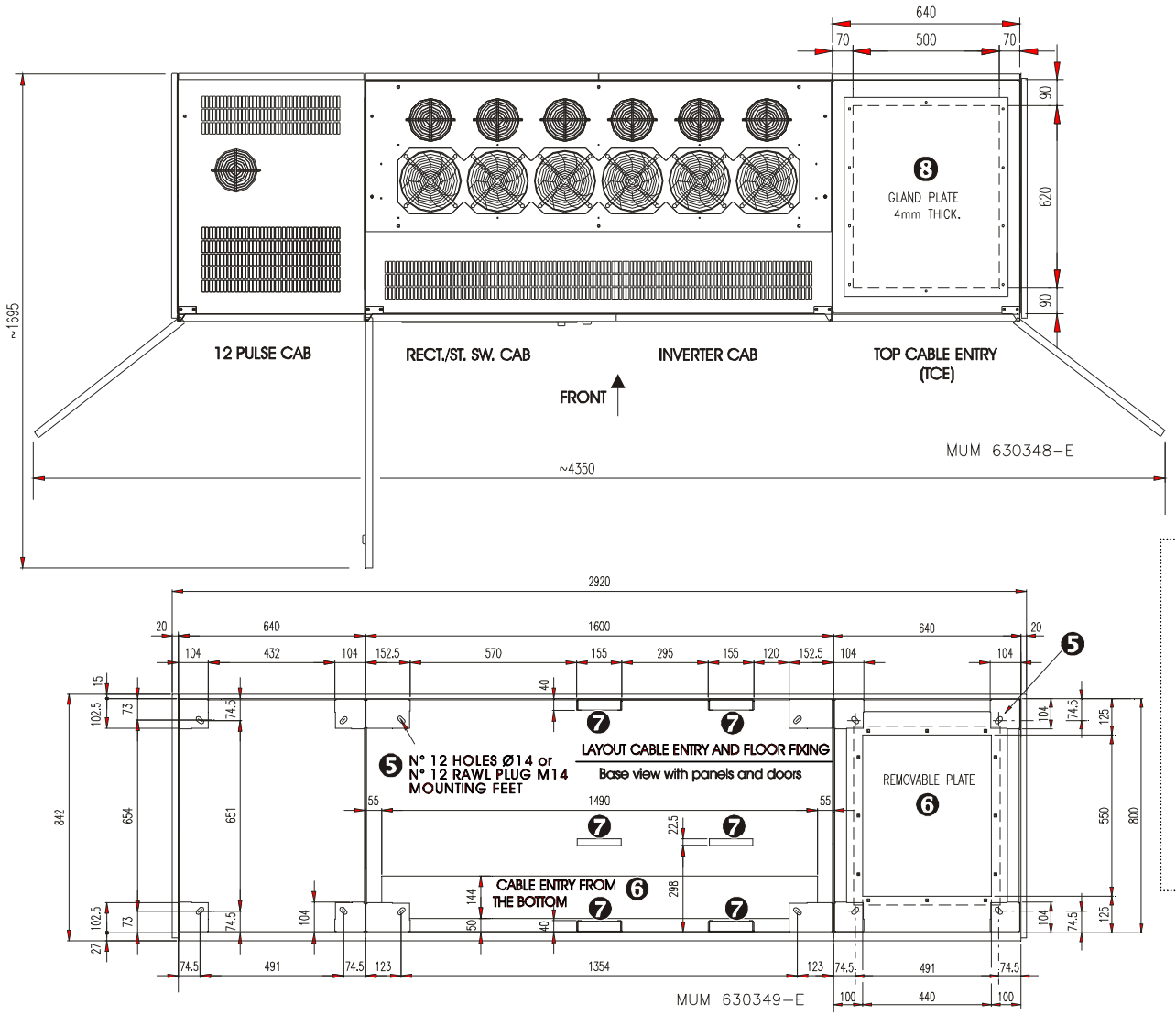
6.1.7 300kVA UPS Module with 12 pulse rectifier with Top Cable entry option



1. Removable grille and panels for lifting with fork-lift truck.
2. Air inlet grille
3. Air exhaust
- 800 mm min. clearance above unit required for air exhaust.
4. Operator control and display panel
5. XTreme label (with option fitted only)

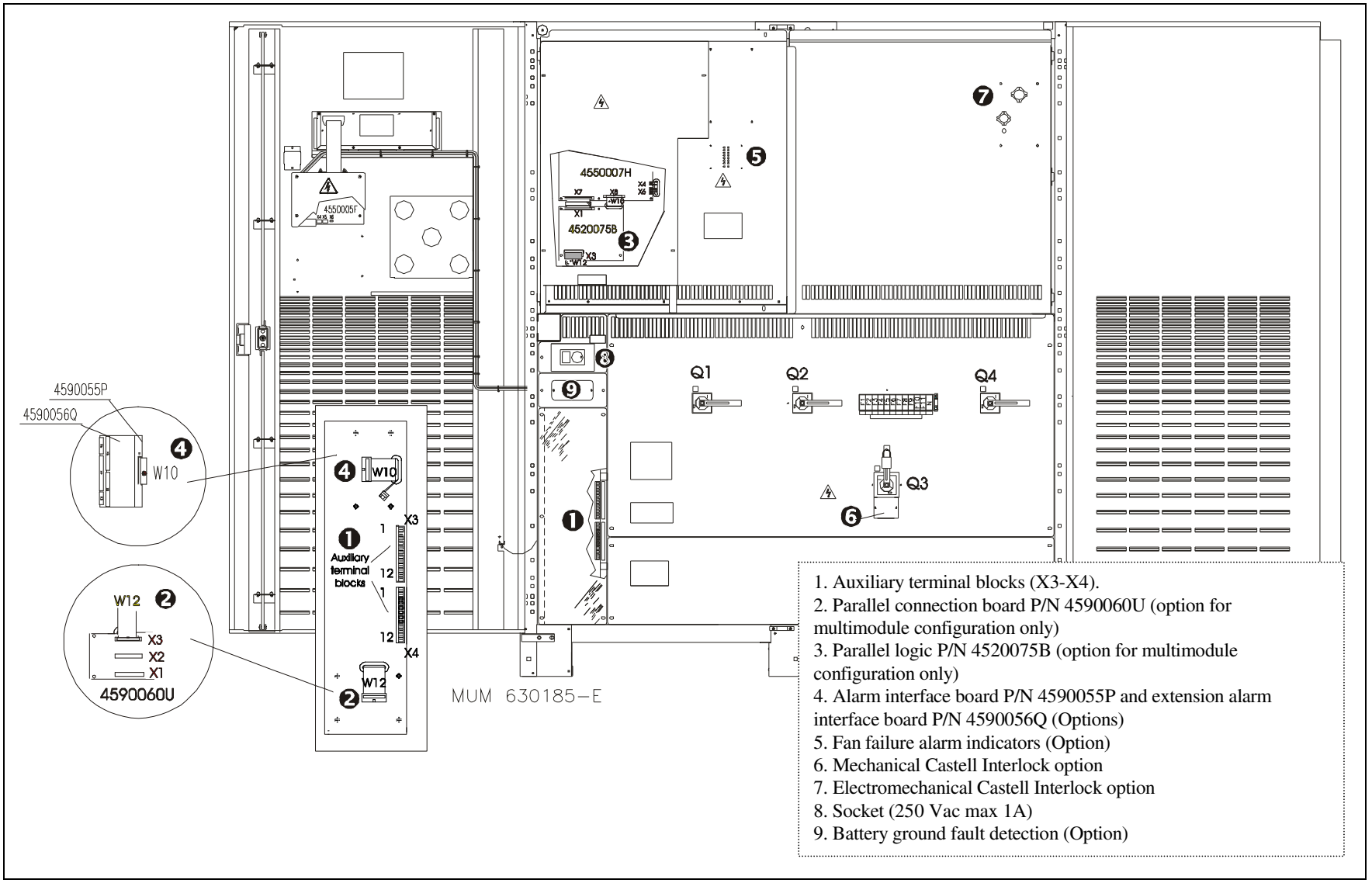
All dimensions are in mm.

6.1.8 300kVA UPS Module with 12 pulse rectifier with Top Cable entry option - Top and base view



Layout cable entry and floor fixing
Base view with panels and doors
5. N°12 holes ∅ 14 for securing unit to floor (if required)
- N° 12 rawl plug M14 -
- Mounting feet
6. Bottom cable entry
7. Load supporting feet
8. Top cable entry (user to size and cut holes for the cables to be used)
All dimensions are in mm.

6.1.9 300kVA UPS Module with 6 pulse rectifier - open door view



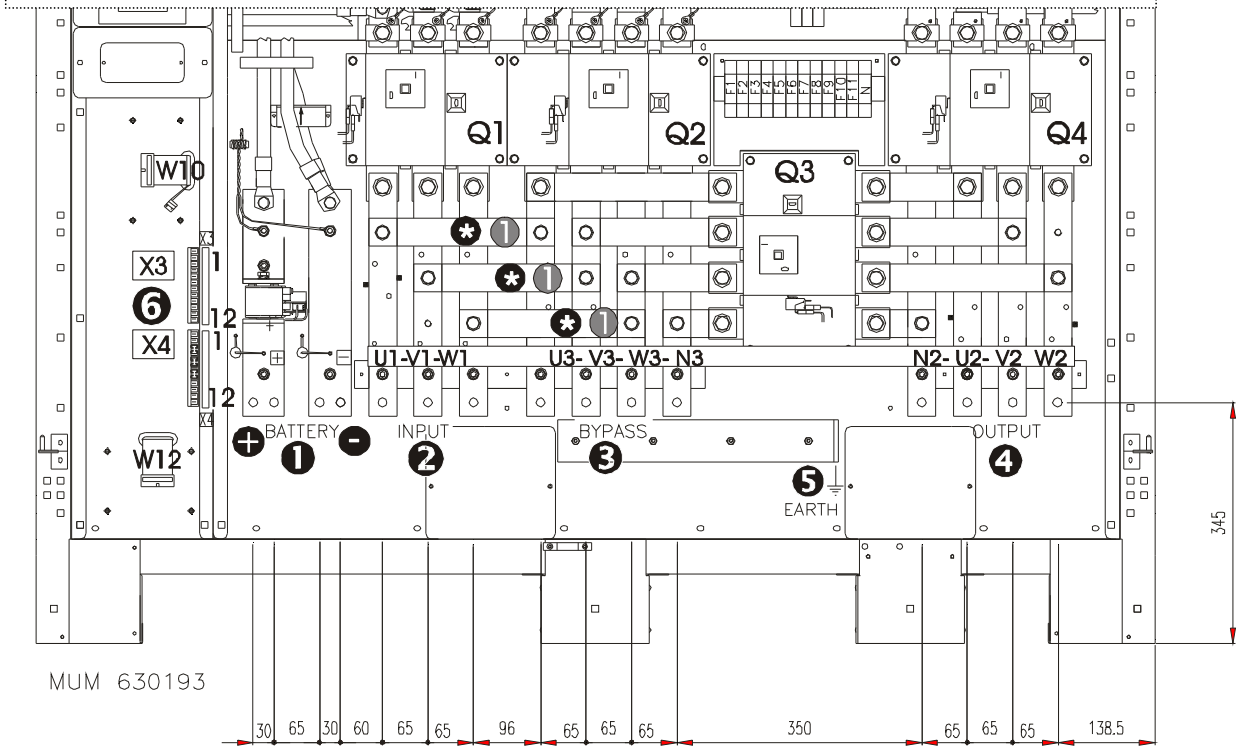
1. Auxiliary terminal blocks (X3-X4).
2. Parallel connection board P/N 4590060U (option for multimodule configuration only)
3. Parallel logic P/N 4520075B (option for multimodule configuration only)
4. Alarm interface board P/N 4590055P and extension alarm interface board P/N 4590056Q (Options)
5. Fan failure alarm indicators (Option)
6. Mechanical Castell Interlock option
7. Electromechanical Castell Interlock option
8. Socket (250 Vac max 1A)
9. Battery ground fault detection (Option)

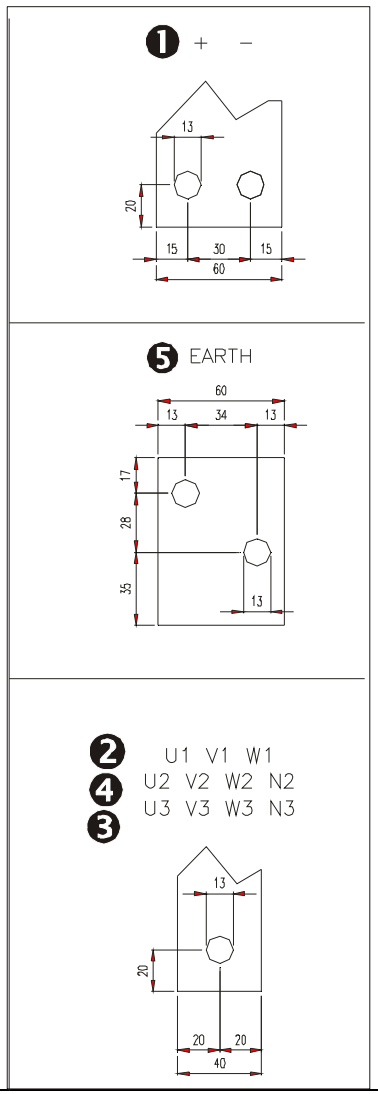
6.1.10 Cable connections for 300 kVA UPS

Note 1: For split Bypass operation ensure that the busbars and cables (*) between Bypass and Rectifier input are removed.
Note 2: With a Class 'A' EMC filter (optional) and a 'common' input configuration, the capacitors on the Rectifier input bars must be removed.

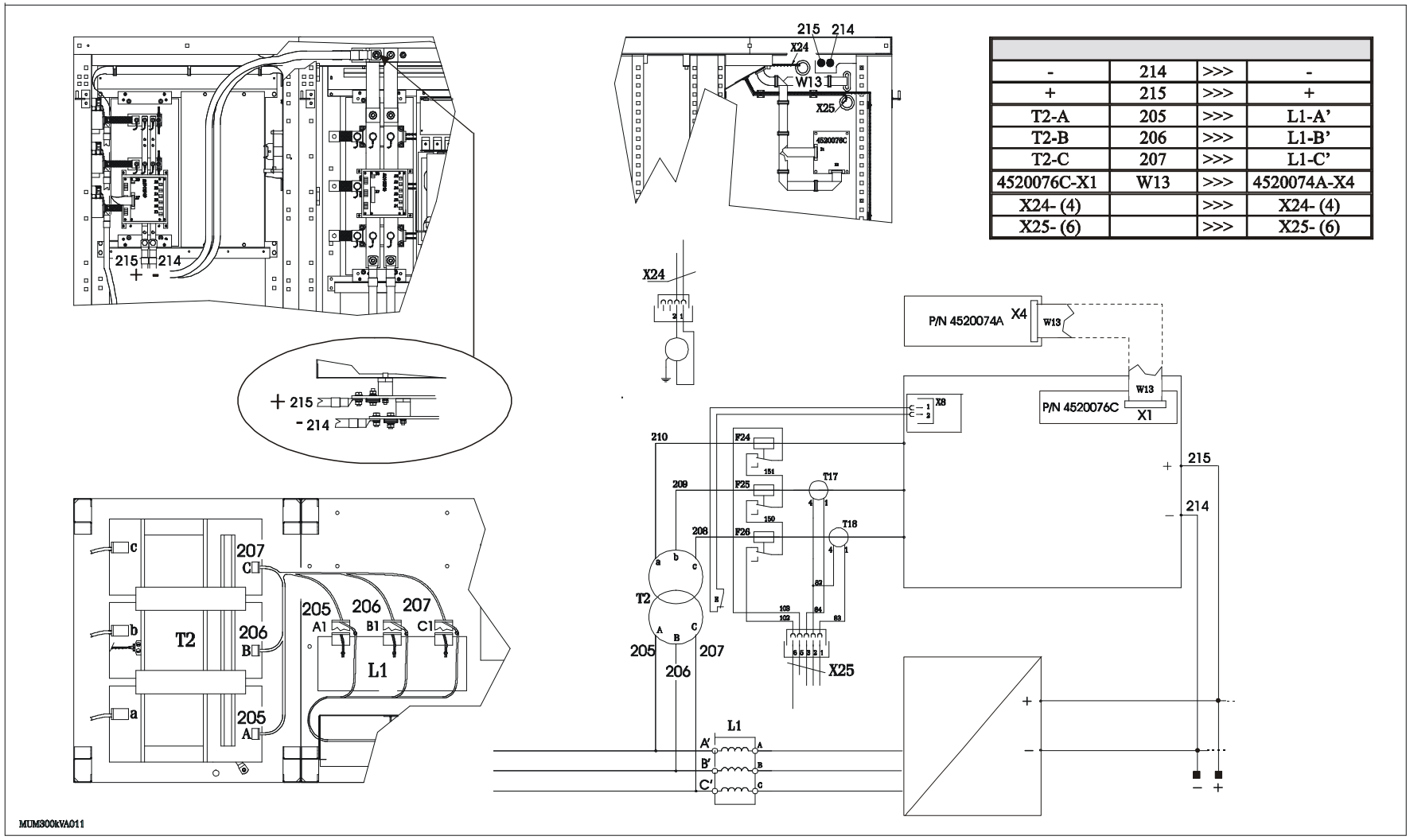
1. Battery connections (+/-)
2. Main input connections (U1-V1-W1)
3. Bypass connections (U3-V3-W3-N3)
4. Output connections (N2-U2-V2-W2)
5. Earth
6. Auxiliary terminal blocks (X3-X4)
7. Details of bar connections

All dimensions are in mm.



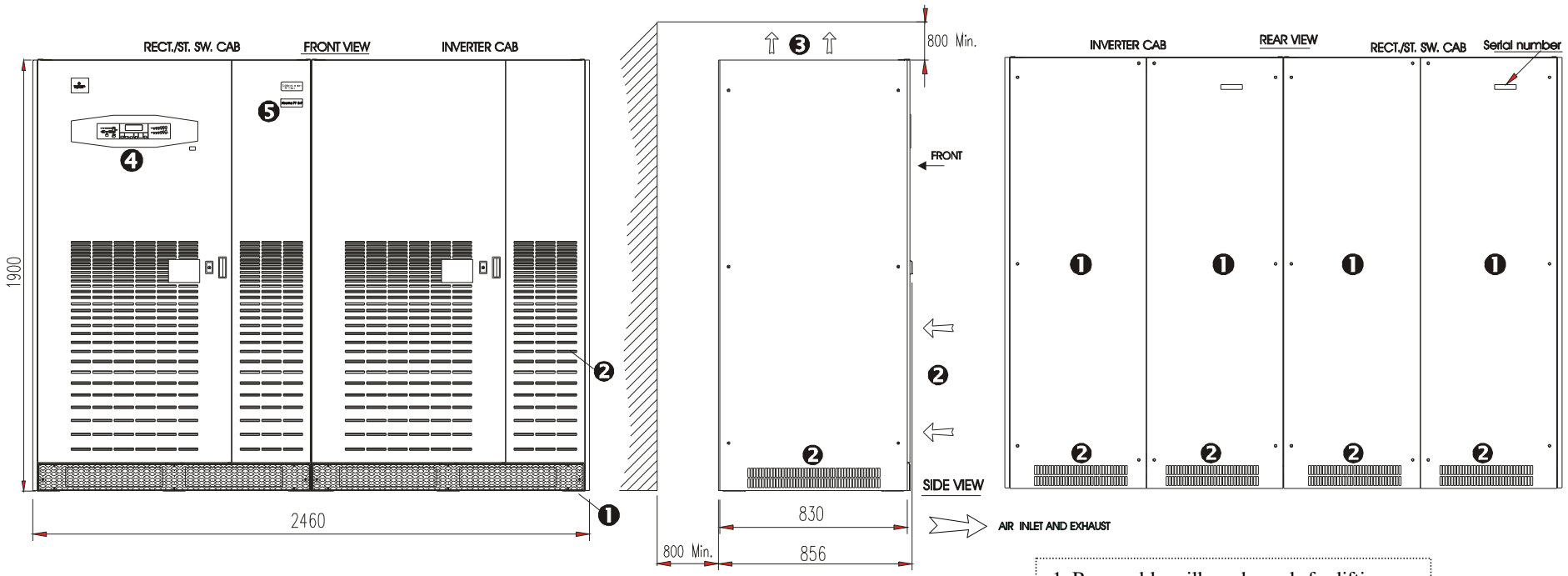


6.1.11 Internal connections between the 300 kVA UPS and the 12 pulse cabinet



-	214	>>>	-
+	215	>>>	+
T2-A	205	>>>	L1-A'
T2-B	206	>>>	L1-B'
T2-C	207	>>>	L1-C'
4520076C-X1	W13	>>>	4520074A-X4
X24- (4)		>>>	X24- (4)
X25- (6)		>>>	X25- (6)

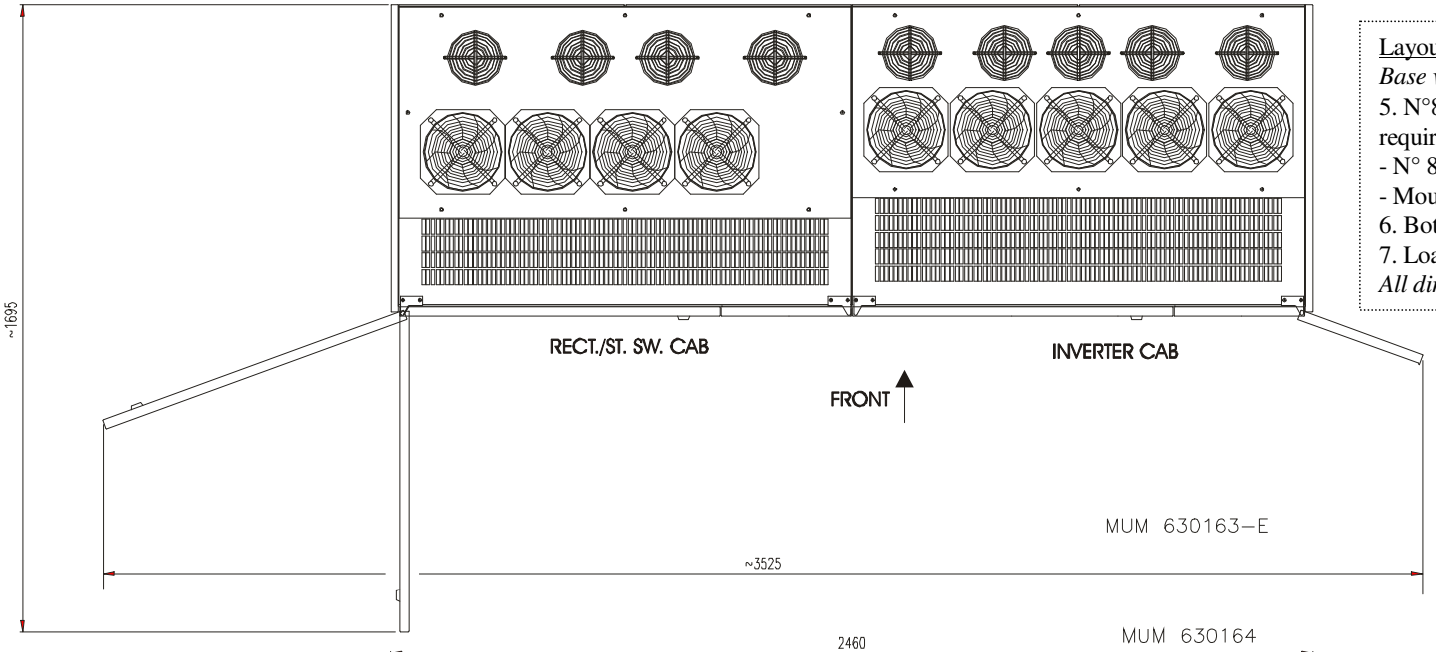
6.1.12 400kVA UPS Module with 6 pulse rectifier (or 12 pulse rectifier)

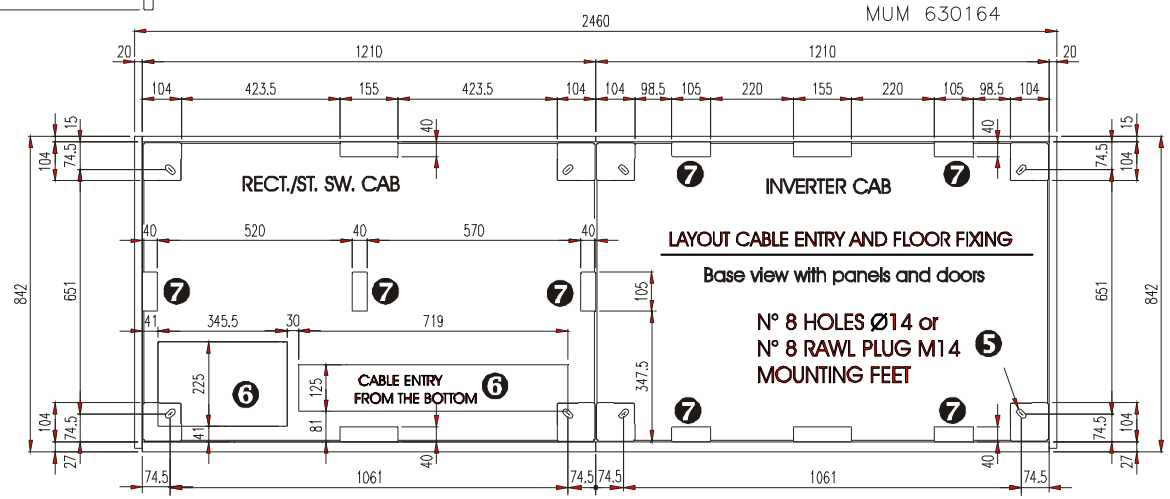


1. Removable grille and panels for lifting with fork-lift truck.
2. Air inlet grille
3. Air exhaust
- 800 mm min. clearance above unit required for air exhaust.
4. Operator control and display panel
5. XTreme label (with option fitted only)

All dimensions are in mm.

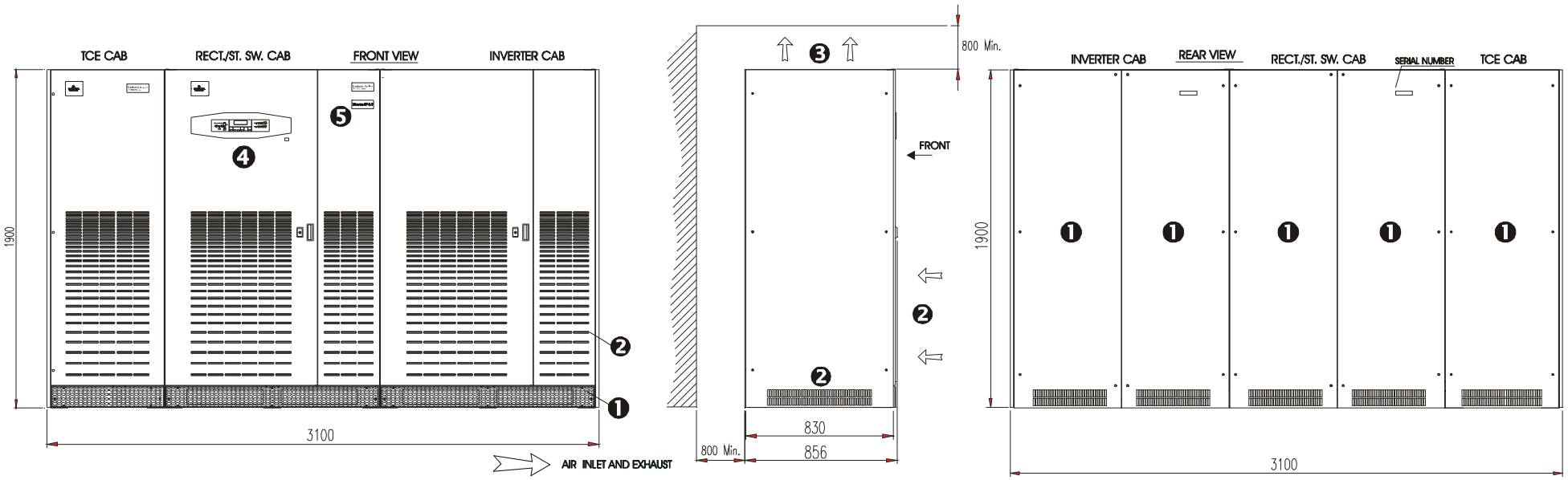
6.1.13 400kVA UPS Module with 6 pulse rectifier (or 12 pulse rectifier) – base and top view





Layout cable entry and floor fixing
Base view with panels and doors
5. N°8 holes ∅ 14 for securing unit to floor (if required)
- N° 8 rawl plug M14 -
- Mounting feet
6. Bottom cable entry
7. Load supporting feet
All dimensions are in mm.

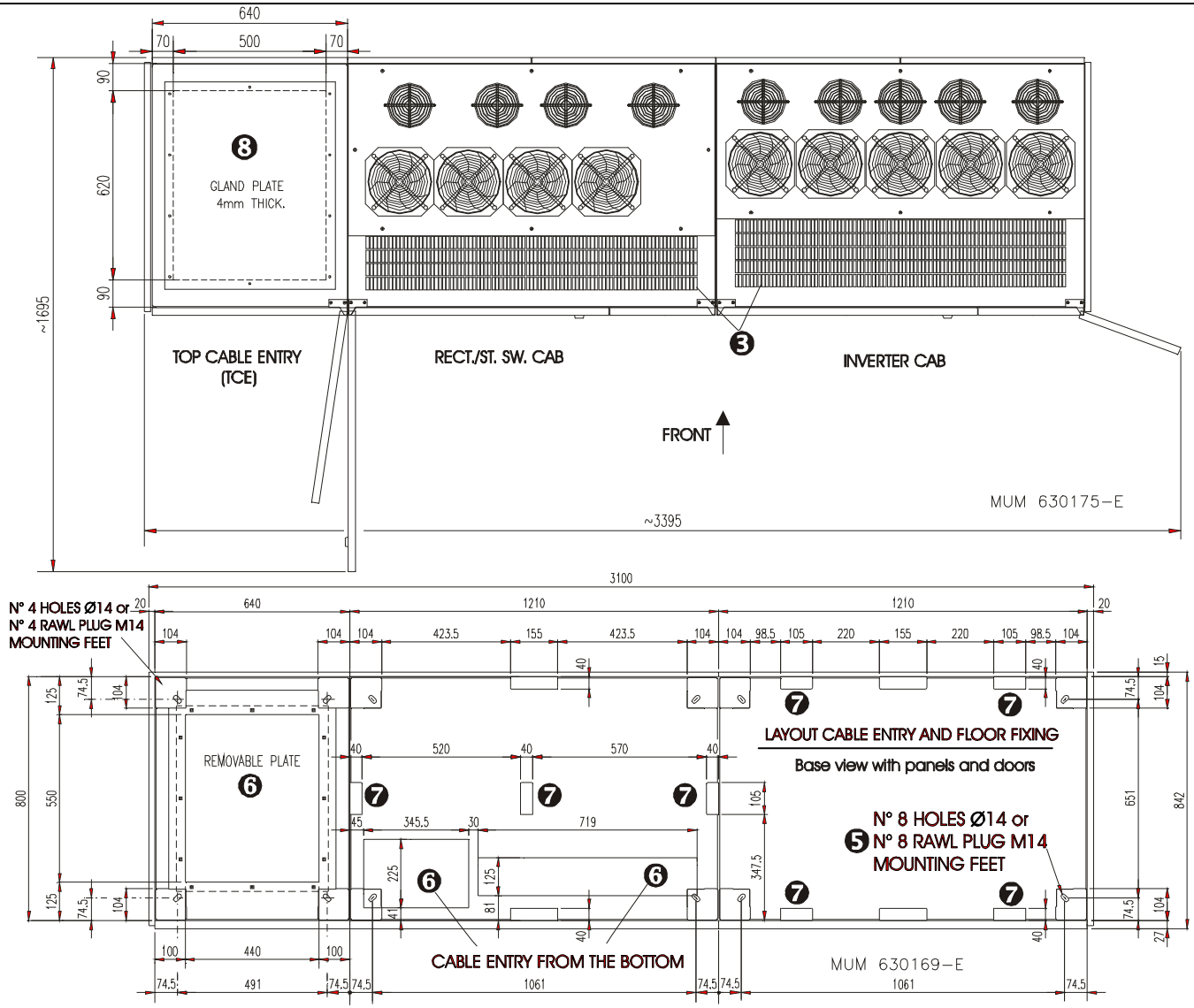
6.1.14 400kVA UPS Module with 6 pulse rectifier (or 12 pulse rectifier) with Top Cable entry option



1. Removable grille and panels for lifting with fork-lift truck.
2. Air inlet grille
3. Air exhaust
- 800 mm min. clearance above unit required for air exhaust.
4. Operator control and display panel
5. XTreme label (with option fitted only)

All dimensions are in mm.

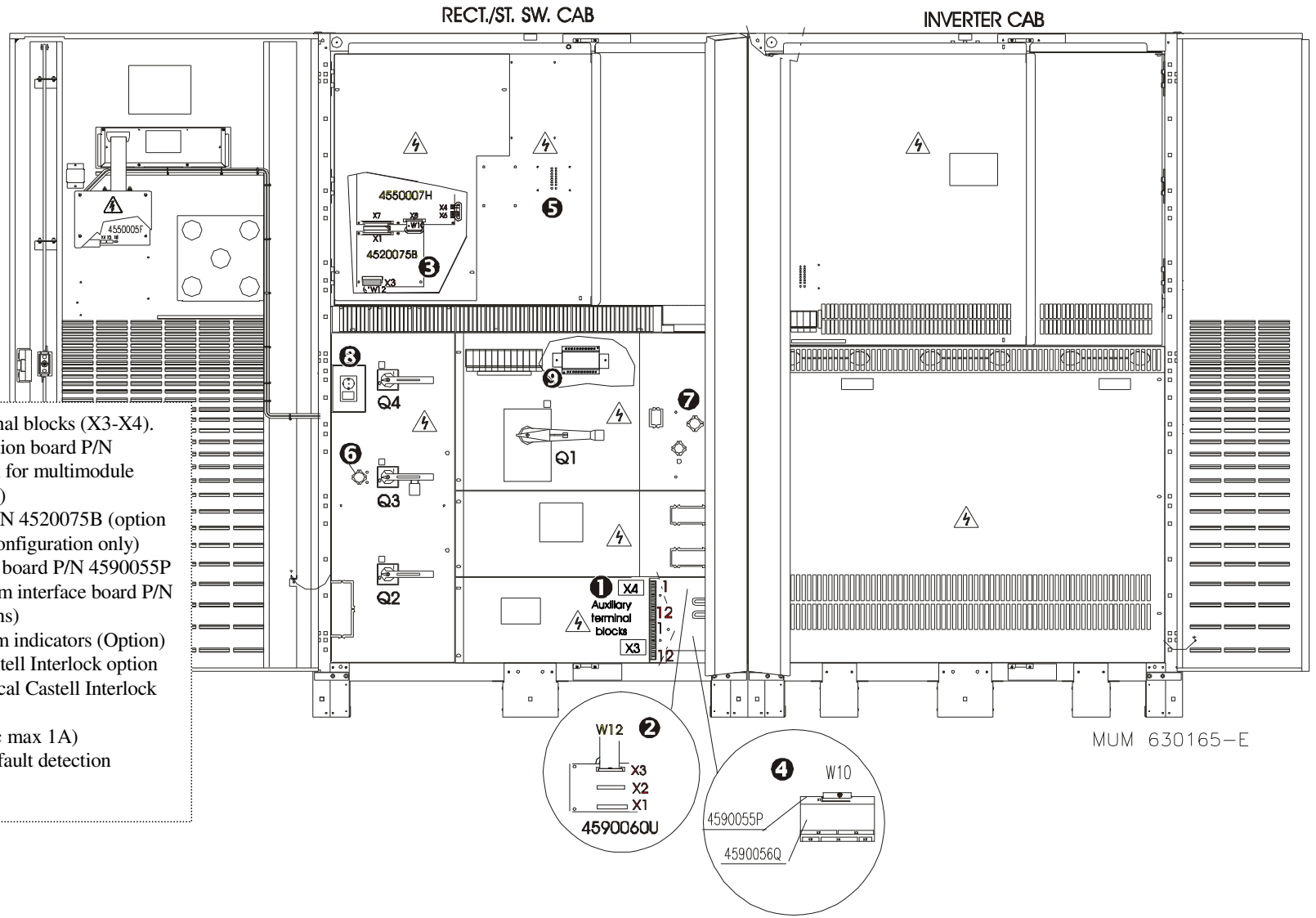
6.1.15 400kVA UPS Module with 6 pulse rectifier (or 12 pulse rectifier) with Top Cable entry option – base and top view



Layout cable entry and floor fixing
Base view with panels and doors
5. N°12 holes ∅ 14 for securing unit to floor (if required)
- N° 12 rawl plug M14 -
- Mounting feet
6. Bottom cable entry
7. Load supporting feet

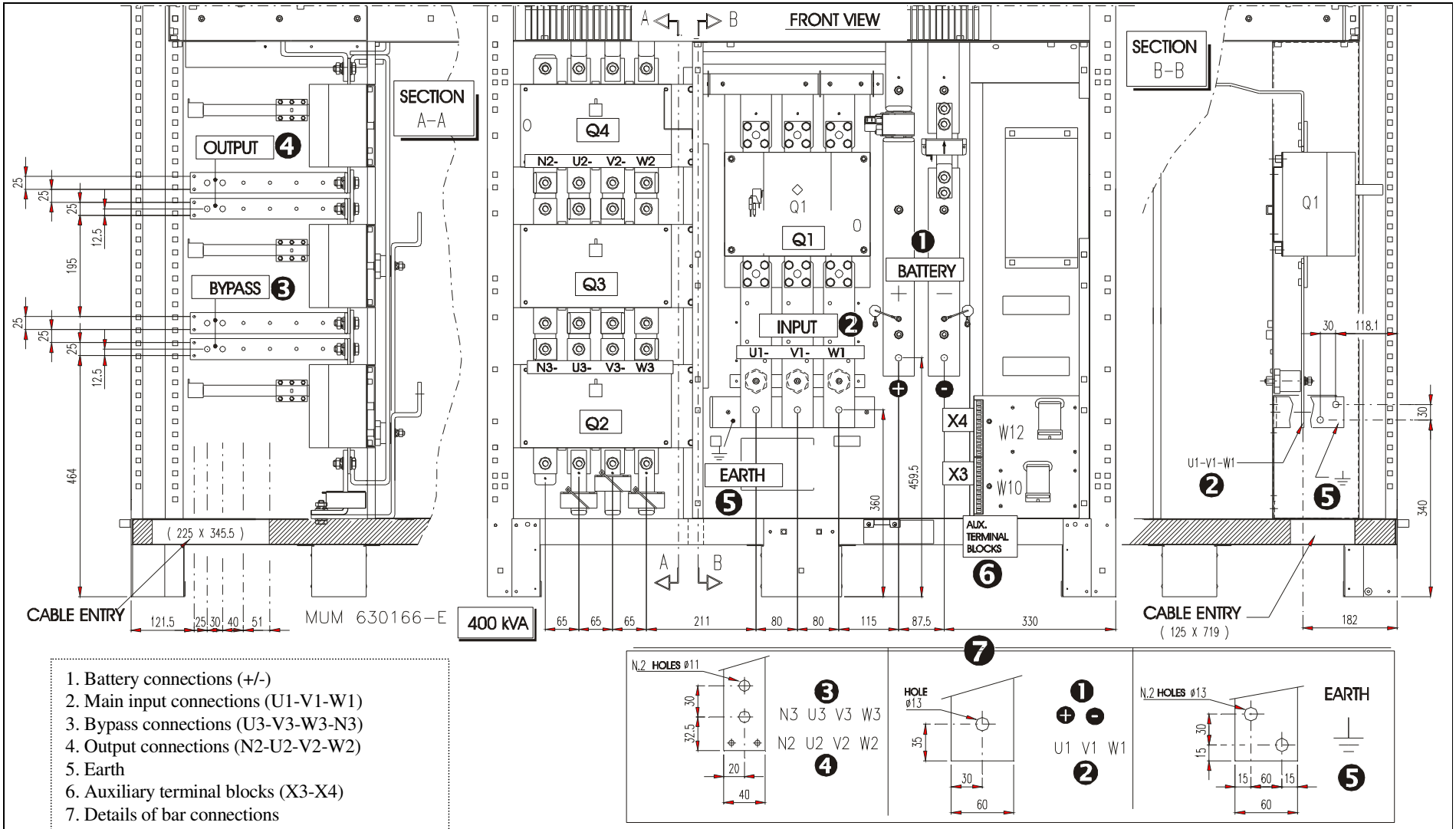
8. Top cable entry (user to size and cut holes for the cables to be used)
All dimensions are in mm.

6.1.16 400 kVA UPS – Front view open doors



1. Auxiliary terminal blocks (X3-X4).
2. Parallel connection board P/N 4590060U (option for multimodule configuration only)
3. Parallel logic P/N 4520075B (option for multimodule configuration only)
4. Alarm interface board P/N 4590055P and extension alarm interface board P/N 4590056Q (Options)
5. Fan failure alarm indicators (Option)
6. Mechanical Castell Interlock option
7. Electromechanical Castell Interlock option
8. Socket (250Vac max 1A)
9. Battery ground fault detection (Option)

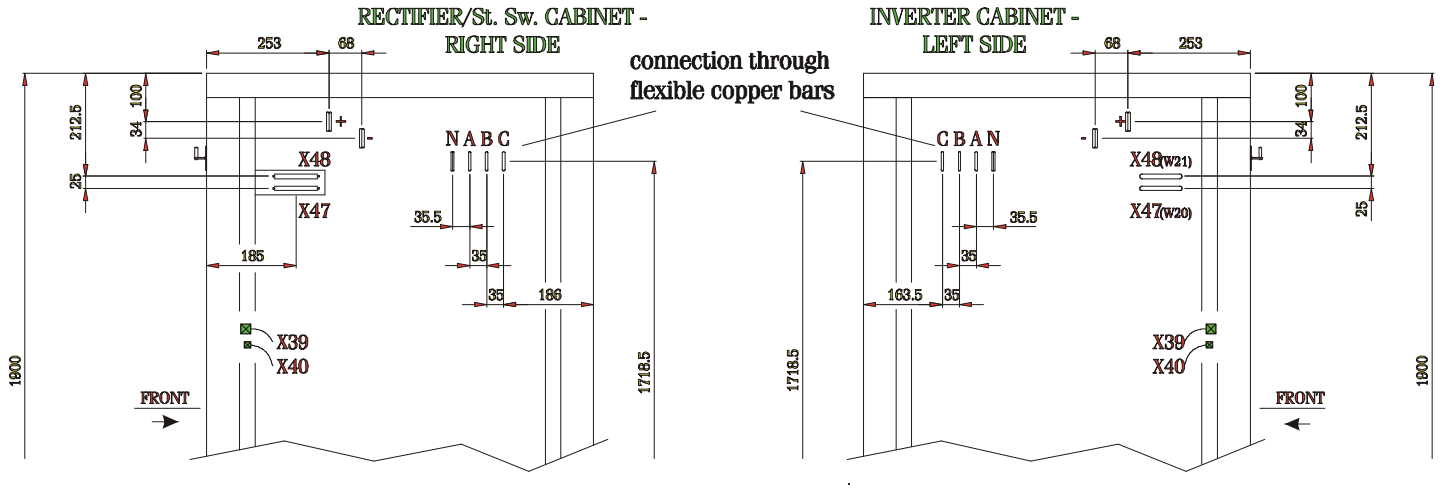
6.1.17 Cable connections for 400 kVA UPS (Rectifier/Static Switch cabinet)

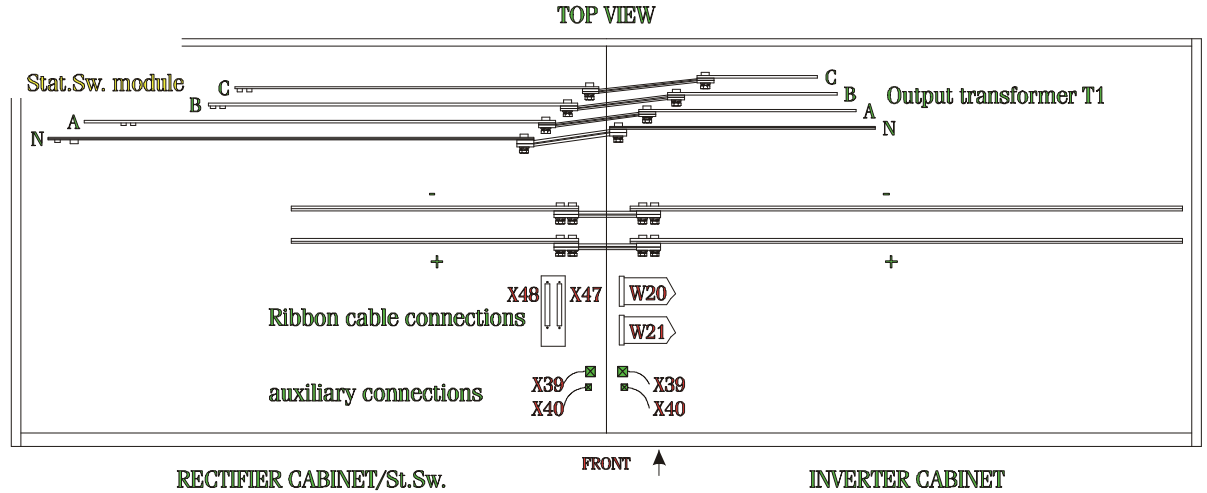


1. Battery connections (+/-)
2. Main input connections (U1-V1-W1)
3. Bypass connections (U3-V3-W3-N3)
4. Output connections (N2-U2-V2-W2)
5. Earth
6. Auxiliary terminal blocks (X3-X4)
7. Details of bar connections

All dimensions are in mm.

6.1.18 400 kVA UPS – View of auxiliary, control signals and power connections between the 400 kVA UPS cabinets

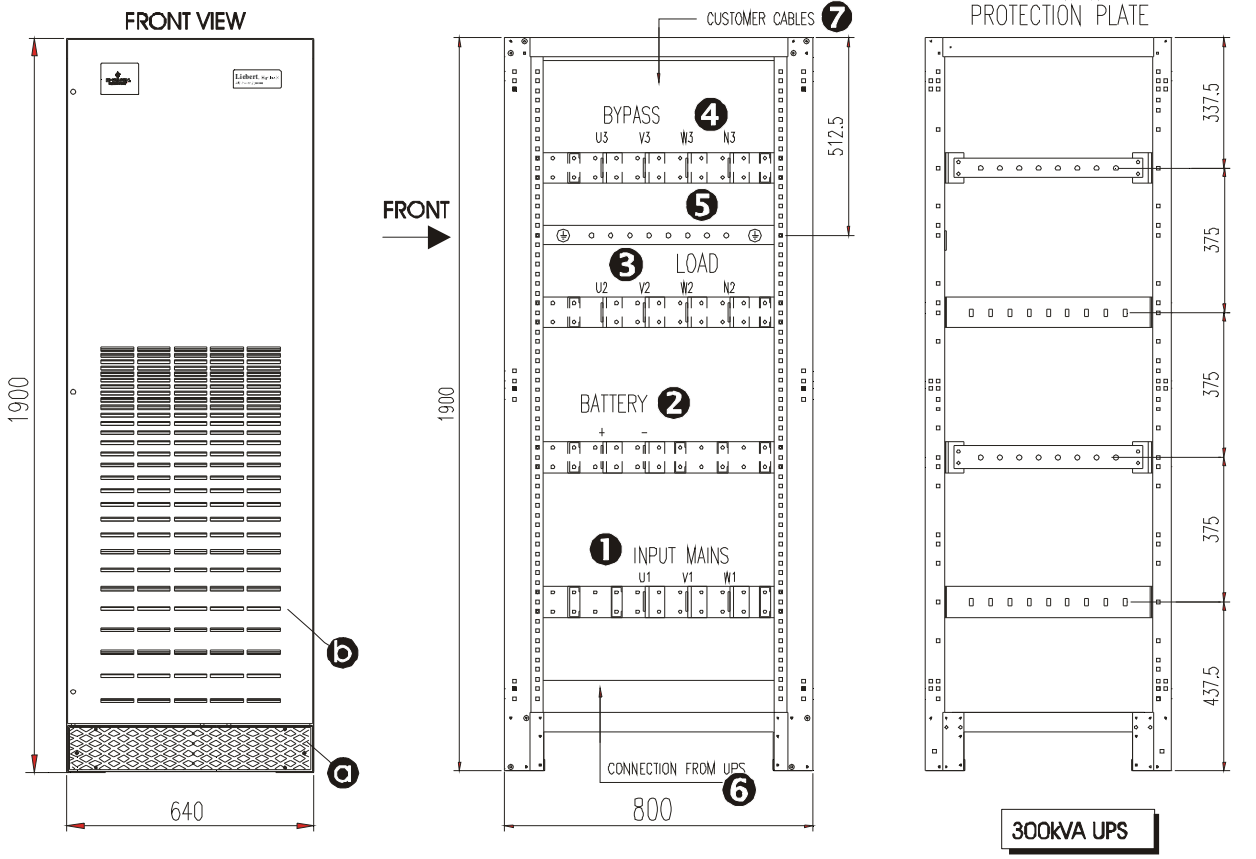




from Rect./St.Sw. cabinet	to Inverter cabinet
N	T1-N (25)
I1- Stat.Sw. module - A	T1-A (16)
I2 - Stat.Sw. module - B	T1-B (17)
I3 - Stat.Sw. module - C	T1-C (18)
+	+
-	-
X39	X39
X40	X40
X47	W20
X48	W21

INTER-MODULE CONNECTIONS
All dimensions in mm.

6.1.19 Top Cable entry option



300kVA UPS

Note: INPUT\BYPASS\LOAD:
COPPER BAR 50 x 5 mm
BATTERY:
COPPER BAR 60 x 6 mm
CONNECTION HOLES ∅12
All dimensions in mm.

400kVA UPS

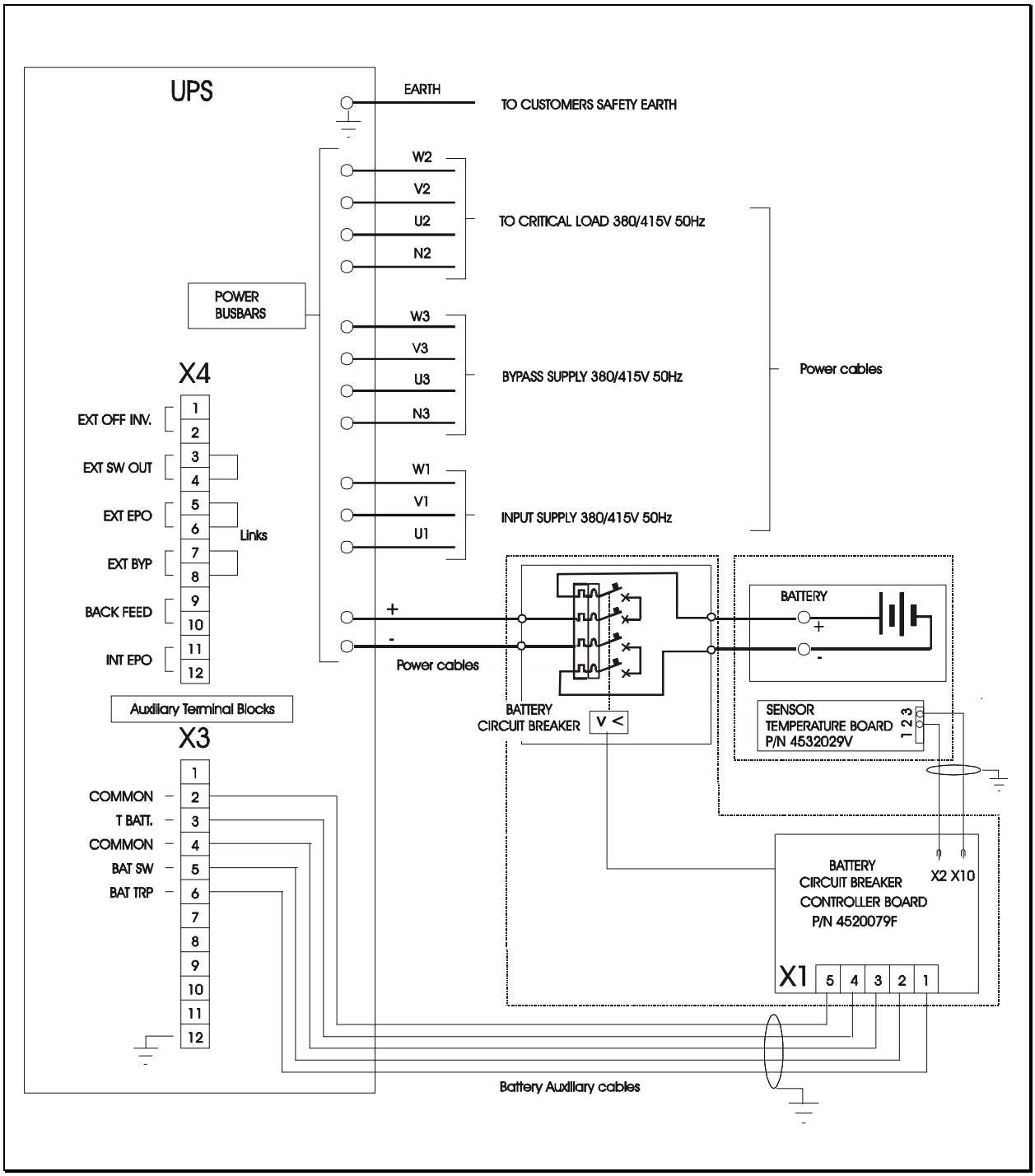
Note: INPUT\BYPASS\LOAD:
COPPER BAR 60 x 6 mm
BATTERY:
COPPER BAR 60 x 10 mm
CONNECTION HOLES ∅13
All dimensions in mm.

a. Removable grille and panels for lifting with fork-lift truck.
b. Air inlet grille
c. Top cable entry (user to size and cut holes for the cables to be used)

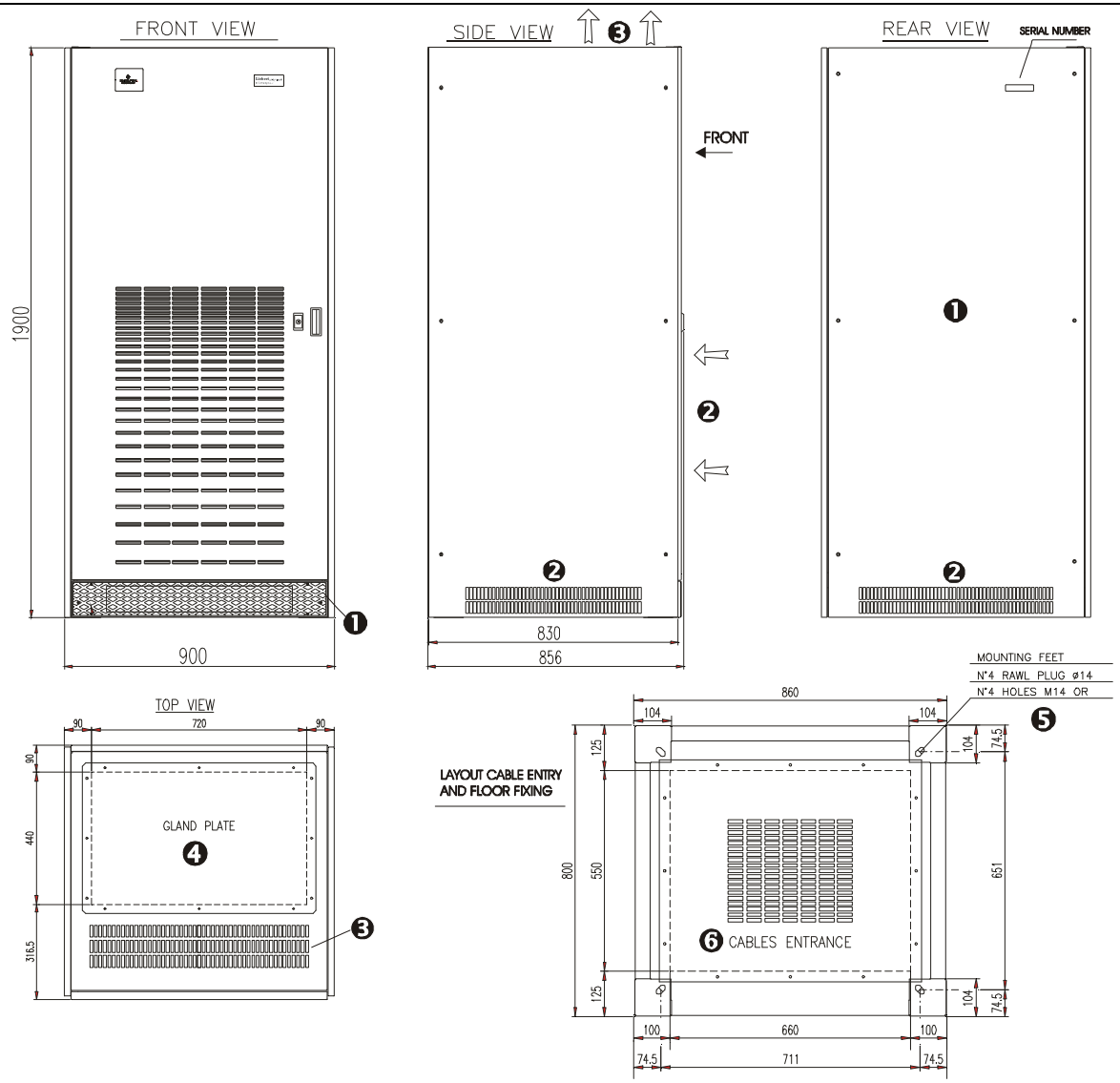
1. Main input connections (U1-V1-W1)
2. Battery connections (+/-)
3. Output connections (N2-U2-V2-W2)
4. Bypass connections (U3-V3-W3-N3)
5. Earth
6. Connection from UPS
7. Customer cables

All dimensions are in mm.

6.1.20 Cable connections for 300 / 400 kVA UPS with Battery Circuit Breaker



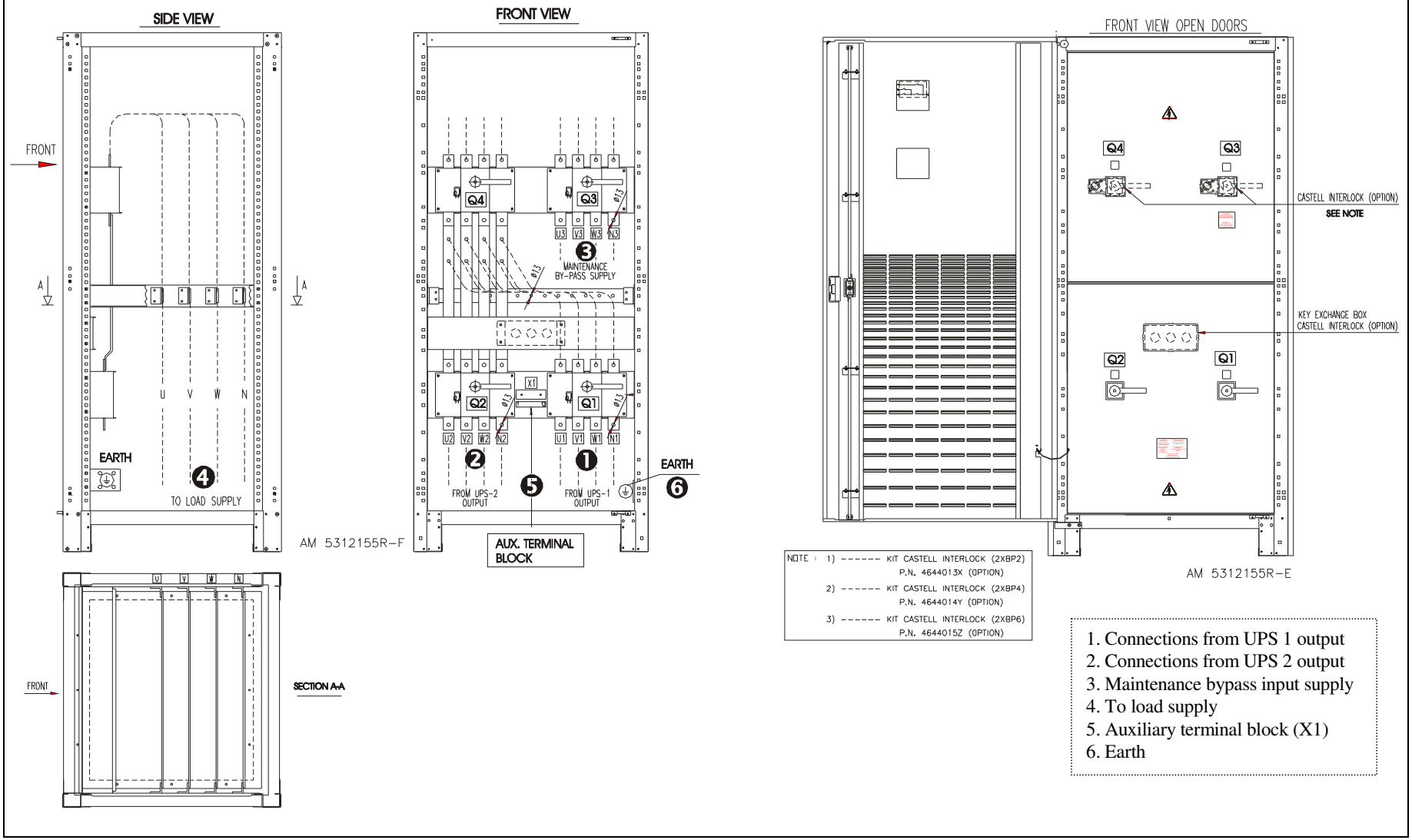
6.1.21 Maintenance Bypass cabinet (Option) – general view



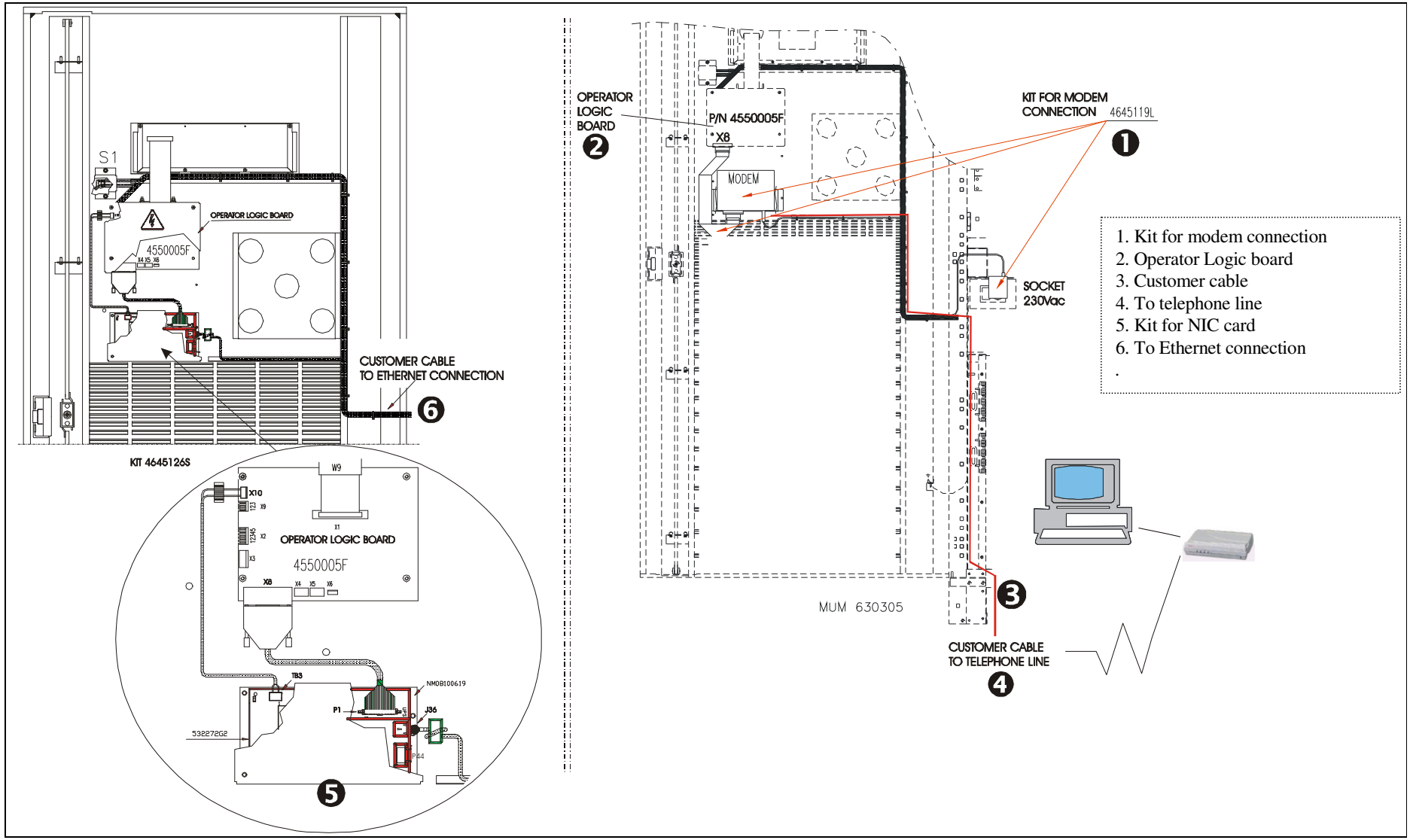
1. Removable grille and panels for lifting with fork-lift truck.
2. Air inlet grille
3. Air outlet grille
4. Top cable entry (user to size and cut holes for the cables to be used)
5. N°4 holes ∅ 14 for securing unit to floor (if required)
- N°4 rawl plug M14 -
- Mounting feet
6. Bottom cable entry

All dimensions are in mm.

6.1.22 Maintenance Bypass cabinet (Option) – Front view with open doors



6.1.23 RS232 Communications for 300-400 kVA UPS (Option) – Modem and NIC card locations



7 Chapter 7 - Additional Equipments

The configuration of a system incorporating the Liebert Hipulse E depends on the specific needs of the installation under consideration.
An installation consists of a number of items of equipment, devices and optional boards.
The options may be prepared for installation either in the factory or directly by the customer.
Brief notes on installation of available options are provided below.
Installers must be thoroughly familiar with the product. More detailed information on installation procedures is provided in the Technical Assistance commissioning manual.

The following options are available for the Liebert Hipulse E:

- Castell Interlock system (see par. 4.4.2)
- Load Bus Synch (LBS) (see par. 7.1)
- Interface Alarm Boards (see par. 7.2)
- Class A filter (see par. 7.5)
- Input harmonic filter (see par. 7.6)
- Additional autotransformer (see par. 7.7)
- Isolation transformer (see par. 7.8)
- Battery ground fault detection (see par. 7.9)
- Fan Failure Alarm Indicator (see par. 7.10)
- Degree of protection for the UPS enclosure (see par. 7.11)
- Intelligent ECOMODE (see par. 7.12)
- XTreme PF Load (XTR 0.9 and 1.0) (see par. 7.13)
- Optional Shipping Air kit (see par. 7.14)

RS232 communications:

- RS232 Communications kit
- Modem
- NIC (Network Interface Card)

RS485 communications:

- Modbus/Jbus
- Remote control panel

WARNING

All options must be installed by Liebert global services or Liebert factory-authorized service provided by a Liebert distributor. The option area and customer control cable area contain hazardous voltage if the input source is on, even when the unit is in bypass. Turn all power sources off before installing customer control cables to any option.

7.1 LBS Control System

The simplest way to create a dual-bus system is with Liebert's exclusive Load Bus Sync (HiSynch) option, which keeps two or more UPS systems in sync, even when operating on batteries or asynchronous gensets. Each UPS powers its own downstream distribution equipment, so that each piece of load equipment can be connected to both.
With the correct transfer devices, any connected load can be switched transparently between sources, so that one complete UPS and distribution system can be powered down for maintenance.

7.1.1 OPERATOR CONTROLS

Operation of the LBS has deliberately been kept as simple as possible. There are only three controls and five indicator lights on the LBS enclosure. The indicators are:

A. **LBS Enabled**. Indicates that the load bus sync circuitry is in the Automatic mode.
B. **System Non-Sync**. Indicates that the DSS is no longer in sync with the DMS. This alarm will indicate during the transition from internal bypass sync to DMS sync.
C. **LBS Active**. Indicates that the LBS circuitry has taken over the sync of the UPS. If the System Non-Sync indicator is also on, it means that syncronization is in process.
D. **Load 1 Sync to Load 2**. Indicates that the UPS critical bus is synchronized to the bypass input of the DMS, in this case UPS #2. This indicator will turn on when the sync process is complete.
E. **Load 2 Sync to Load 1**. Indicates that the UPS critical bus is synchronized to the bypass input of the DMS, in this case UPS #1. This indicator will turn on when the sync process is complete.
F. All indicators mentioned above are supplied with **volt free contacts** for remote monitoring.

Standard LBS controls are:
A. **Mode Select Switch**. Provides manual selection of automatic operation or "Off" modes. In the Automatic mode, the LBS will be enabled. In the Off mode, both UPSs will synchronize independently.
B. **Master Select Switch**. Provides manual selection of the DMS source. The LBS circuitry will automatically switch DMS sources should the initially selected DMS lose its bypass input.
C. **Lamp Test**. Push this button to test indicator lights.

7.1.2 OPERATOR PROCEDURES

The only two operator controls are the Mode Select Switch and the Master Select Switch. The Mode Select Switch can be left in the Automatic position all the time. The Off position can be selected at times when it is desired to let the UPSs synchronize independently.
The Master Select Switch allows the operator to choose which UPS bypass source will provide the reference sync signal. In normal operation, both UPS systems will be functioning and the LBS Mode Select Switch will be in the Automatic position. The LBS Enable indicator will be lighted, as will one of the indicators for Load X Sync to Load Y. If the two UPS drift out of sync (while on generator or battery, for example), the LBS Active and System Non Sync indicators will be lighted. The Load X Sync to Load Y indicator will be off during the synchronization process and turn back on when the process is complete.

7.2 Interface Alarm Boards

7.2.1 Introduction

Two circuit boards, each offering different features and facilities, are available to provide alarm signalling to external devices:

- I\O AS400 Alarm Interface Board (4590055P).
- Extension Alarm Interface Board (4590056Q).

All alarms are generated via software routines on the UPS Logic Board and output from the micro data bus via a series of controlled output buffers. The signals then pass via a piggy-back connection through the Alarm Interface Board (4590055P) to the Remote Alarm Interface Board (4500056Q) where they energise appropriate relay coils via switching transistors.
The AS400 Alarm Board (4590055P) is mounted on the internal metal panel shown in Chapter 6 and connected to ribbon cable (W10 on all models). The Extension Alarm Board (P\N 4500056Q) is also fitted.

Note

As compared to previous models, the two alarm interface boards feature new alarms and additional functions (Field defined alarms). Verify that the UPS is using software version 15 or above (by selecting Info window on the display of the operator's panel).

7.2.2 Board Installation – 4590055P

1. Before installing the AS400 Alarm Interface Board in the UPS, it is necessary to power down that unit. To maintain continuity of supply, the load should first be transferred to the maintenance bypass circuit following the procedure given in the Operation Manual.
2. Mount the AS400 Alarm Interface Board on the plastic stand-offs that are already mounted on the internal metal panel inside the UPS at the location identified in the figures of Chapter 6.
3. Turn the plastic screwhead of the plastic standoffs in a clockwise direction.
4. Connect the ribbon cable (W10) to connector X1 on the AS400 Alarm Interface Board (4590055P).
5. Connect the external signal cables, as required, to the terminal block connectors identified in the appropriate sections of this user manual.

Note: The cross-sectional area of the signal wires may be 0.1 to 1.5mm^2 and should take into account the working voltage of the remote monitoring interface device and the length of the cable route. Inside the UPS the signal cables should be bundled together and tied to the metal frame.

6. Return the UPS to Normal Operation, following the procedure given in the Operation Manual.

7.2.3 Board Installation – 4590056Q

1. Using the connector X1, mount the Extension Alarm Interface Board (4590056Q) in piggy-back fashion on to connector X2 of the AS400 Alarm Interface Board (4590055P.)
2. Connect the external signal cables, as required, to the terminal block connectors identified in the appropriate sections of this user manual.

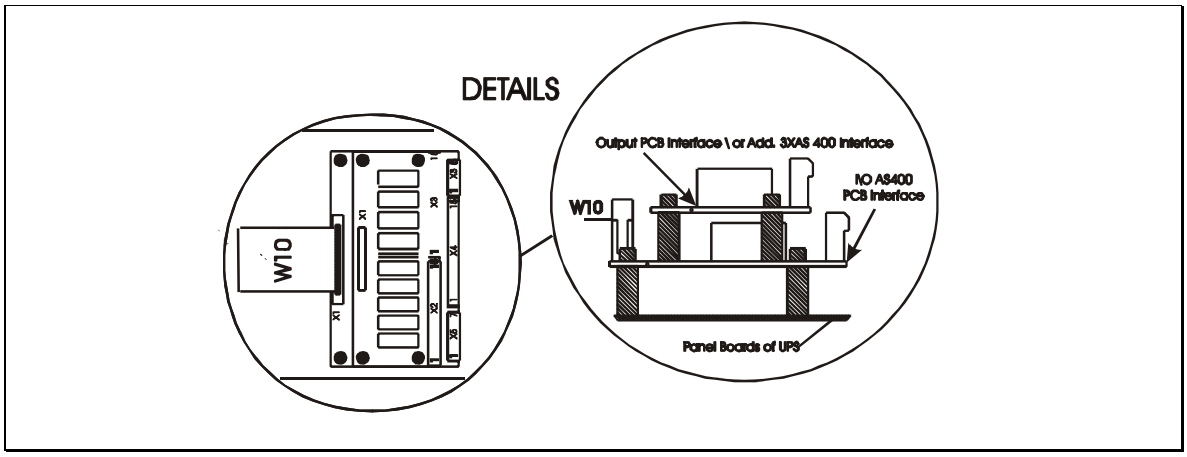


Figure 7-1 – UPS Interface Alarm Boards details

7.3 UPS I\O AS400 Alarm Interface Board (P\N 4590055P)

This board has several functions as described below.

7.3.1 Remote Control Inputs (X5)

The Interface Board has facilities to accept three remote control inputs on terminal block (see Note 1), as shown in figure 7-2. The remote controls are:

Reference			Definition	Setting	Definition
X5	1-2	❸	*Static Switch block*	Insert jumper on X6 1-2	This remote input blocks the load on the inverter side, thus preventing the switching to the bypass mode (this function is used for the LBS option).
			Battery ground fault	Insert jumper on X6 2-3	This input is used to enable the alarm on the UPS operator's panel both in the event of insulation loss of the battery. (This feature is available if the battery ground fault detection option has been installed)
			Manual/Auto Restart		The inverter will start automatically up after a loss of mains, if 'AUTORESTART ON' remains selected as default in the operator display panel; instead when 'MANUAL RESTART ON' has been selected, the inverter will start only when an external signal (12 Vac/dc) is applied to this input. Set this function in 'Setup - UPS – SETUP - RESTART' windows by operator's display panel
	3-4	❷	*Inverter Off*	Set function in the 'Function - I/O Board Setup - External block' window by operator's display panel	This remote input allows the inverter to be shut down (transferring the load to the bypass supply). See Note 2
			Rectifier Off		This remote input allows the rectifier to be shut down. See Note 2
			Static switch Off		This remote input allows the static switch to be shut down. See Note 2
	5-6	❶	*On generator*	Set function in the 'Function - I/O Board Setup - Generator' window by operator's display panel	This remote input is most often used in conjunction with a stand-by generator, which may be activated when the input mains supply fails. The effects of this input can be configured from the Operator Control Panel to a combination of the following: reduce the input current limit; reduce the battery current limit; inhibit the inverter/bypass synchronisation .
			Ecomode	Set function in the 'Setup - System configuration' window by operator's display panel	This input allows switching UPS from double conversion to ECOMODE by Digital Input function. UPS will put the load on the Bypass line with the Inverter in stand-by.

Important Instructions

Depending on customers' requirements, X5 remote control inputs may have different functions according to setting by operator's panel or hardware jumper X6. For how to set by Display the wanted function, see the menu in the Operation Manual.

The voltage applied to these terminals must be generated by an external power source and not taken from the UPS internal low voltage supplies.

NOTE

1) Control is achieved by application of control signals (12V d.c. or a.c.) to terminal block X5 as shown in figure 7-2.

2) These three remote control inputs or each of them can be used to enable the specific functions described above. This window is protected by a password that restricts the access of users to complex control functions, which are however accessible without limitations to authorized servicing personnel. Always verify that all changes of original settings are recorded in the commissioning documentation.

7.3.2 AS 400 Interface (X3)

The AS400 Alarm Interface Board connects the four most operationally critical UPS alarms to an IBM AS400 computer, which is designed to monitor such alarms and respond to their appearance. Connection to the AS400 is provided on the Alarm Interface Board via a terminal block X3. These alarm signals are provided by volt-free relay contacts, Maximum contact rating is 50 Vdc @ 1A.
The alarms in question are:

- **UPS Bypass ❾** (RL-K6)

This warning message signals that the load is powered by the static bypass and is not protected by the distortion of the mains supply. This signal is disabled if the 'ECOMODE' mode has been selected.

- **Battery Low ❿** (RL-K7)

This alarm is enabled only if the maintenance bypass switch is open, the load is *"on-inverter"*, and the rectifier is stopped for any reason. The alarm then activates when the battery voltage falls below the minimum programmed Low Battery Level.

- **UPS ON** (RL-K8)

This warning message signals that the load is suppied by the UPS regardless of whether it is used as inverter or static bypass. This signal is disabled if the load is set to the maintenance bypass.

- **Utility Failure** *(Rectifier mains)* (RL-K9)

This alarm is enabled only if the maintenance bypass switch is open and the load is *"on-inverter"*. The alarm then activates when the rectifier is stopped for any reason.

❖ **Common**

7.3.3 Alarm Outputs (X4)

In addition to the AS400 alarm outputs the Interface Board also contains a number of relays whose contacts provide a set of volt-free alarm outputs that are connected to terminal block X4 as shown in figure 7-2. These outputs can be used to drive an external alarms monitoring device. Maximum contact rating on terminals = 50 Vdc @ 1A.

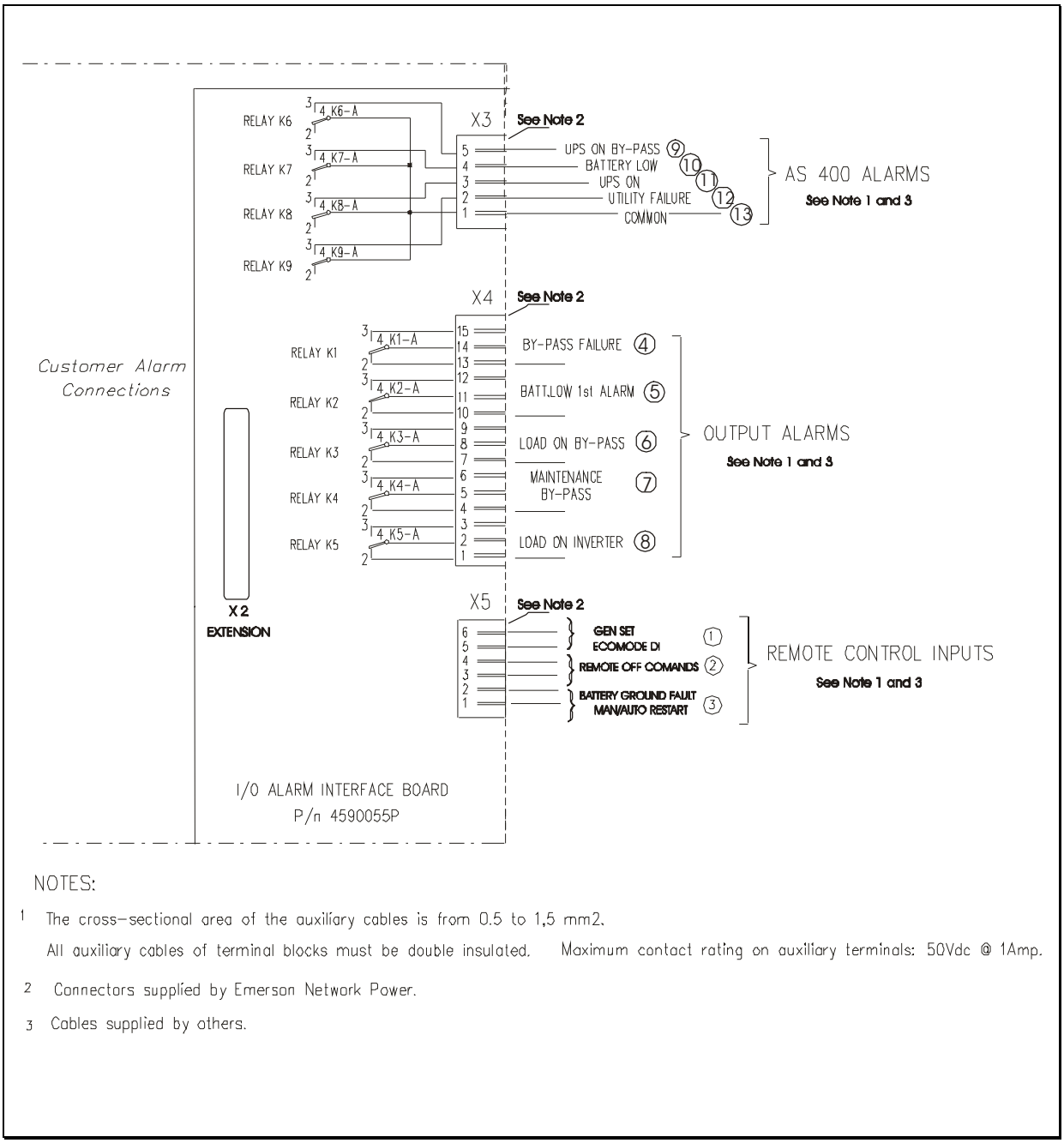
The alarms in question are:

- **Bypass failure ❹** (RL-K1)
  This alarm is active when the bypass voltage is low (undervoltage alarm), the bypass voltage is high (overvoltage alarm) or absent; or the bypass-side static switch is selected blocked via the Operator Control Panel menuing system.
- **Low battery** (pre-alarm) or Battery CB open **❺** (RL-K2)
  This alarm is active when the battery breaker is open, the battery fuse is open or the Low Battery alarm is active.
- **Load on static bypass ❻** (RL-K3)
  This warning message signals that the load is supplied by the static bypass and not protected by the distortions of the mains supply. This signal is opposed to 'LOAD ON INVERTER' on relay K5. The signal is normally present when the UPS is in 'ECOMODE' and running in normal operating conditions.
- **Load on maintenance bypass ❼** (RL-K4)
  This status message signals that the load is supplied by the maintenance bypass line and that it is not protected by the distortion of the mains supply. The alarm is enabled by the closing of the maintenance manual bypass switch (Q3).
- **Load on inverter ❽** (RL-K5)
  This status message signals that the load is normally supplied by the inverter.

Note: When using the above contacts for remote alarm annunciation, the power supply for the remote indicators must be provided from an external power source. Under no circumstances should the UPS internal low voltage supplies be used for this purpose.

7.3.4 X2 Extension

The X2 connection on the board is provided to interface to the Extension Alarms Interface Board (P\N 4590056Q), which is described next.



NOTES:

1 The cross-sectional area of the auxiliary cables is from 0.5 to 1,5 mm2.
All auxiliary cables of terminal blocks must be double insulated. Maximum contact rating on auxiliary terminals: 50Vdc @ 1Amp.

2 Connectors supplied by Emerson Network Power.

3 Cables supplied by others.

Figure 7-2 – UPS I\O AS400 Alarm Interface Board (P\N 4590055P)

7.4 UPS Extension Alarm Interface Board (P\N 4590056Q)

This board is connected (piggy back style) directly via connector X1 onto the Interface Board connector X2 of 4590055P as shown in figure 7-1. This board can only be used in conjunction with the Interface Board (4590055 P).

7.4.1 Standard Alarm Outputs

The Extension Alarm Interface board contains a number of relays driven by alarm signals generated within the UPS, whose contacts provide a set of volt-free alarm outputs that are connected to terminal blocks X2 and X3 as shown in figure 7-3. These outputs can be used to drive an external alarms monitoring device.

Reference			Definition	Description
X2	RL K1	15 NO 14 COM 13 NC	**BATTERY ON LOAD ❶**	This message informs the operator that the load is supplied from the battery system and the battery is discharging. This alarm is enabled when the battery breaker is closed and the battery fuse in intact and then active when rectifier block signal is present.
	RL K2	12 NO 11 COM 10 NC	**OVERLOAD ❷**	This message informs the operator that the load exceed 150% of the UPS rating, and the load will transfer to bypass some time later depending on the degree of overload present.
	RL K3	9 NO 8 COM 7 NC	**INVERTER OVERTEMPERATURE ❸**	This alarm is active when an output transformer overtemperature or an inverter overtemperature is enabled (thermostat on heatsink is intervened).
	RL K4	6 NO 5 COM 4 NC	**INVERTER UNSYNCHRONISED ❹**	This warns that the inverter is not synchronised with the bypass supply, which is normally due to a problem with the bypass supply being outside an acceptable frequency window. In 1+N parallel system one (or more) UPS is not synchronised with other modules or with bypass supply.
	RL K5	3 NO 2 COM 1 NC	**COMMON ALARM ❺**	This is a general alarm facility and is activated from any of the following: • Rectifier blocked. • Battery c.b. open, battery fuse fail, DC bus undervoltage. • Inverter is unsynchronized. • INV: Overtemperature is active. • OUT: undervoltage/ no voltage, wave form error. • Inverter: OFF, blocked, INV: current limit, undervoltage. Additional alarms for 1+N configuration: • Bypass-side static switch is blocked (inhibited) by hardware. • Bypass supply failure. • Bypass OFF/ overvoltage/ undervoltage • Maintenance Bypass isolator is closed • Number inverters not OK
X3	RL K6	15 NO 14 COM 13 NC	**FAN FAILURE ALARM ❻**	This message informs the operator that there is a failure in the outgoing air ventilation system (with option included).
	RL K7	12 NO 11 COM 10 NC	**TRANSFER ON BYPASS INHIBIT ❼**	This alarm is activated from any of the following: • the bypass has been inhibit by the operator from either the front panel display or an external PC. • one or more of the UPS static switch SCR's has developed a fault. • input ac supply failed or out of specified acceptable range. • bypass switch open. This alarm is valid only for UPS units in single configuration and not for the '1+N' configuration.
	RL K8	9 NO 8 COM 7 NC	**NOT USED ❽**	
	RL K9	6 NO 5 COM 4 NC	**BACK FEED FAULT ❾**	This message informs the operator that failure of the Bypass static devices has resulted in voltage being fed back to the bypass supply input.
	RL K 10	3 NO 2 COM 1 NC	**BATTERY C.B. OPEN**	The battery circuit breaker is open. Note that if the mains power fails then the UPS output will also fail together with load power, since the inverter has no battery back-up. Verify that the jumper is setting on X4 1-2.
X1		Connect piggy-back to X2 of Alarm Interface Board (P\N 4590055P)		

Note: relay contacts refer to the power-free card.

Maximum contact rating on aux terminals: 50 Vdc @ 1 Amp.

Note: When using the above contacts for remote alarm annunciation, the power supply for the remote indicators must be provided from an external power source. Under no circumstances should the UPS internal low voltage supplies be used for this purpose.

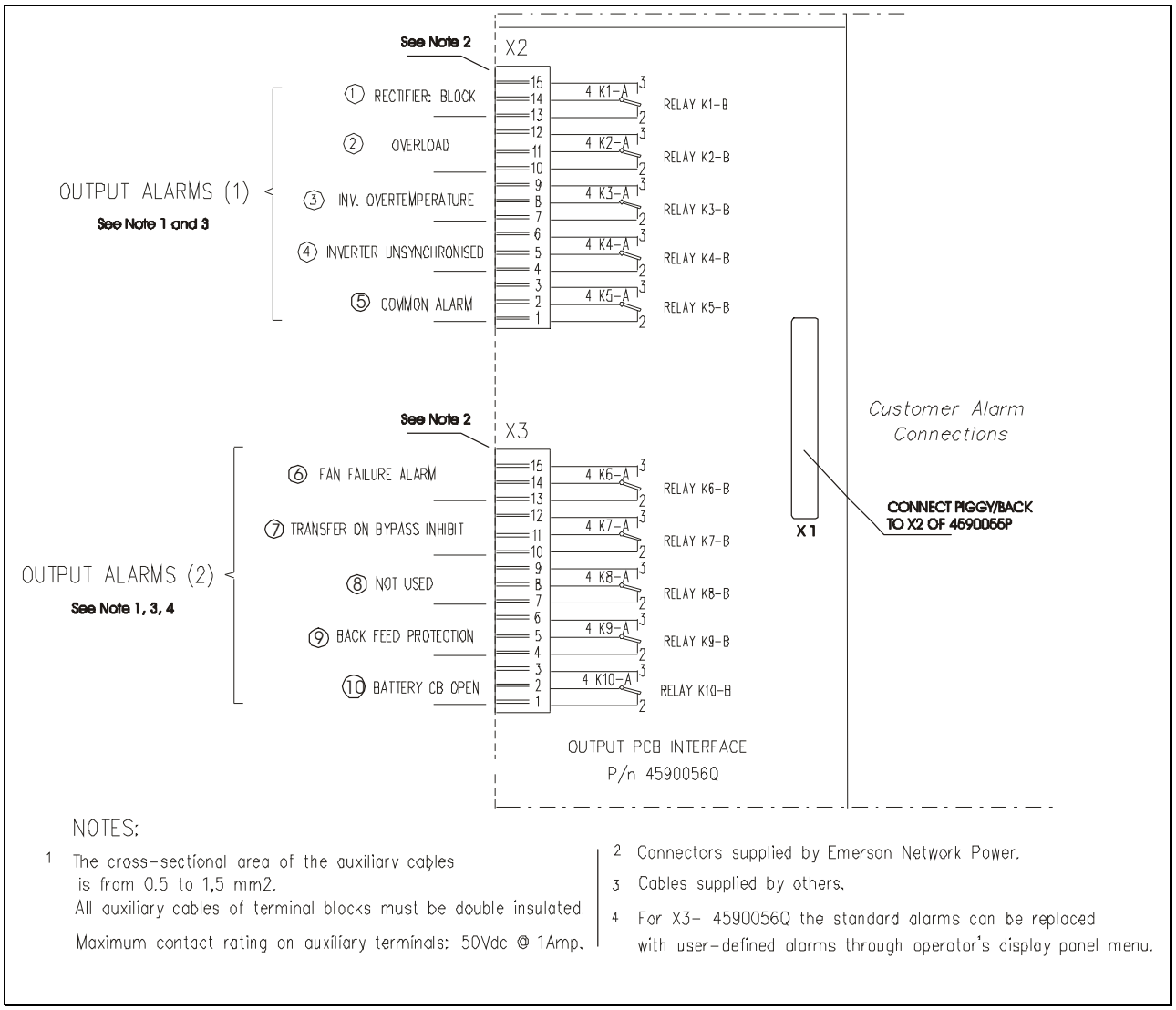


Figure 7-3 – UPS Extension Alarm Interface Board (P\N 4590056Q)

7.4.2 Field defined alarms (X3 auxiliary terminal board)

The user may ask for the standard alarms to be replaced with five user-defined alarms, which can be selected among the 80 alarms available within the UPS. It will however be necessary to set the related alarm code (see Display Panel Messages in the Operation Manual) by means of the relevant selection window in the operator's panel. The UPS will make this available on the X3 terminal block of *alarm interface extension board (*Code 4500056Q) as soon as it is detected. This window is protected by a password that restricts the access of users to complex control functions, which are however accessible without limitations to the authorized servicing personnel. From DEFAULT WINDOW, pressing ENTER key, select FUNCTION>PASSWORD> IN/OUT BOARD>OUT RELAY Kxx. Always verify that all changes of original settings are recorded in the commissioning documentation.

7.5 EMC Class A filter

To convert to Class 'A' UPS, the following factory installed optional EMC kits must be fitted (to require when placing the order).

Model	P/N
300 kVA UPS (6&12 pulse)	4641134E

This option is needed to control the single and combined effect of both radiated and conducted noise within the range of specified EN and IEC Standards. Refer to Chapter 6 'Installation drawings'.

7.6 Input Harmonic Filter (5th and 11th)

Properly designed tuned filters are available to reduce the most critical harmonic pollution (5th and 11th).
They also can improve the Liebert Hipulse E input power factor, leading Power Factor (P.F.) from 0,8 up to 0,93.
These optional input filters can be installed without any additional system footprint.

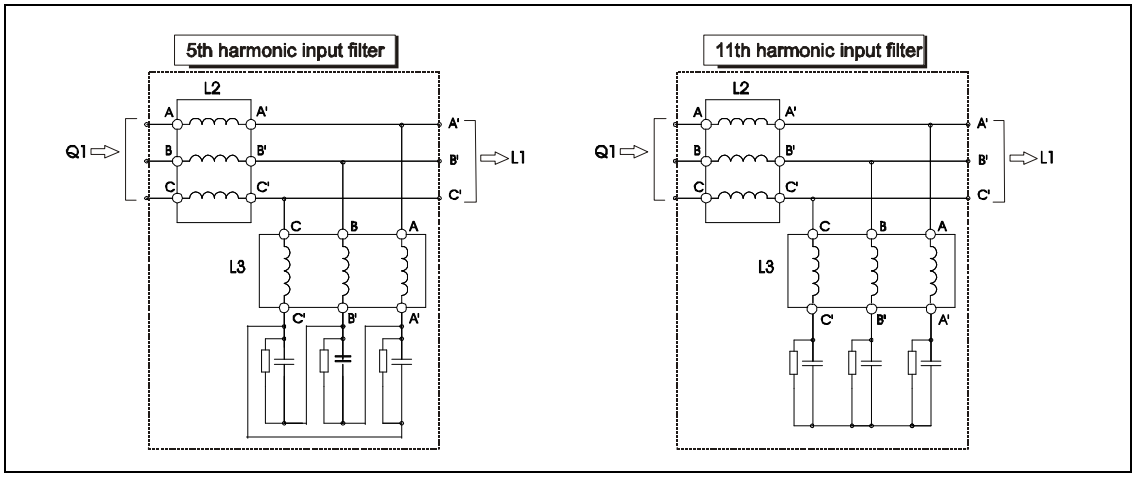


Figure 7-4 – Optional input filter schematic

5th harmonic filter

This optional harmonic filter can be fitted in the 6 pulse UPS to improve the UPS input power factor and reduce the amount of electrical noise reflected into the input three phase supply.

Model	P/N	Weight (kg.)
300 kVA UPS	4641182A	160
400 kVA UPS	4641183B	184

11th harmonic filter

This filter can be fitted in a 12 pulse UPS.

Model	P/N	Weight (kg.)
300 kVA UPS	4641065N	106
400 kVA UPS	4641153X	132

7.7 Additional autotransformer

When the mains voltage or the voltage required by the load has a different value in respect to the UPS standard value, an autotransformer for the voltage adjustment can be added.

7.8 Input isolation transformer (IT)

Input Isolation Transformers are required in case of having a galvanic isolation between Input/Bypass Mains and UPS Output. They are normally a Delta/ZigZag (△/Z) double wound transformer and they are available for every range of UPS (80-800 kVA). They are housed in an optional cabinet in which the non automatic circuit breaker with fuses are also installed. Input isolation transformers are designed to power both rectifier and bypass mains, depending on their size.

The transformers have 0° phase shift to also allow connection in the bypass line.
The IT cabinet can be positioned alongside the main UPS equipment.
All cabinets are secured and bonded together using the holes provided in the cabinet side struts. Each cabinet is supplied without side covers, as the cover from the basic UPS is then used. If the cabinet is to be located away from the UPS, connection cables and side panels will be necessary.
All IT models are cooled with the aid of internal removable fans.

The components of the Input isolation transformer are matched to the UPS capacity, resulting in different part numbers for each system as follows:

Model	P/N	Dimensions (WxDxH) mm.	Weight (kg.)	Switches	Fuses (A)
300 kVA UPS	5312125N-E	1210 x 856 x 1900	1250	3p – 630A	630 Gr.3
400 kVA UPS	5312126O-E		1450	3p – 1250A	900 Gr.4

Note: Side panels not included.

When the IT is fitted next the UPS is provided with the power connection cables. If for any raison the IT cannot be fitted next the UPS, please order the optional side panels.

7.9 Battery ground fault detection

To guarantee a continuously uninterruptible power supply to the critical load, single module UPS or parallel UPS systems are provided with external batteries, so the battery insulation to PE (Protection Earth) shall be monitored to be in a safe range. For this purpose the battery system is fitted with a DC monitoring device to detect and eliminate earth faults to ensure operational continuity, this is included in a Battery Fault Detection Set.
The Battery Ground Fault Detection is the same for all UPS sizes.
When a battery ground fault is detected, an alarm will appear on the display panel (if the interface card is installed within UPS and X6 jumper has fitted on 2-3).
A remote warning may be provided by installing an other alarm interface card.

The Battery ground fault detection (P/N 4645313X) contains fault detection device only. The wiring cables are already installed within UPS. This option is fitted on DIN guide as shown in the installation drawings in Chapter 6.

7.10 Fan Fail Detection

Liebert Hipulse E system controls the correct operation of fans.
On failure of any fan within the UPS system, the Fan Failure Alarm Indicator (P/N 4536005T-B) allows the user to easily identify its location. The feature includes the Fan Failure Detect PWA (one per cabinet), various 'sensor' cards (one per fan), interconnection units (loose and anchored connector) and wiring. This function employs cards fitted with an electromagnetic device installed on each individual fan, which gives an alarm signal on the operator display panel and turns on a Led on the Fan Failure Alarm Indicator in the event that a fan slows down or shuts down entirely.
The Fan Failure Alarm Indicator is installed on the internal door.

Model	Control fan P/N	Fans
300 kVA 6P	4641149T-B	E1 to E12
300 kVA 12P	4641157B-B	E1 to E13
400 kVA 6P	4641198Q	E1 to E18
400 kVA 12P		

7.10.1 Installation

The kit is currently factory installed.
For 300 kVA 12P UPS: The additional auxiliary connections must be made when joint the 12 pulse cabinet to UPS, by inserting the loose connectors (X108 and X109) in the relative fixed connectors.
For 400 kVA 6 and 12P UPS: The additional auxiliary connection must be made when joint the two UPS cabinets, by inserting the loose connector (X95) in the relative fixed connectors.
To permit easy location of the fan failure, the top view of the UPS is printed next to the Fan Failure Alarm Indicator. For example on 400kVA, if the INV led comes on (named INV), the fan failure is located in the Inverter cabinet and the corresponding Led comes on (named E1÷10).

7.11 Degree of protection for the UPS enclosure

The degree of protection for the UPS enclosure satisfies IP 20 standard even in door-opened condition. An option for **IP21/30/31** is also available.

7.12 Intelligent ECOMODE (For single unit only)

The Electronic key option fitted on UPS Logic board allows activating the modality of the intelligent ECOMODE functions through setting menu of the operator display panel. From Default Window, pressing Enter key, select FUNCTION / SETUP / CONFIGURATION / ECOMODE xx. The three following functional modality are:

- Digital Input: This screen allows switching UPS from double conversion to ECOMODE through X5 remote input of the I/O Alarm board (P/n 4590055P). The UPS will put the load on the Bypass line with the Inverter in stand-by.
- Time based periodic ECOMODE: This screen allows setting daily operation.
- Load Level Selection: The UPS will switch to ECO-MODE when the load reaches the user settable low level. The UPS will switch back to Inverter when the load percentage (50% default value) arises over the threshold minimum level plus a given settable Hysteresis.
  There are two type of operative mode: Ecomode HL or Ecomode LH
  Ecomode HL: If this mode is set then the inverter will sustain the load when load above threshold level.
  Ecomode LH: If this mode is set then the inverter will sustain the load when load below threshold level.

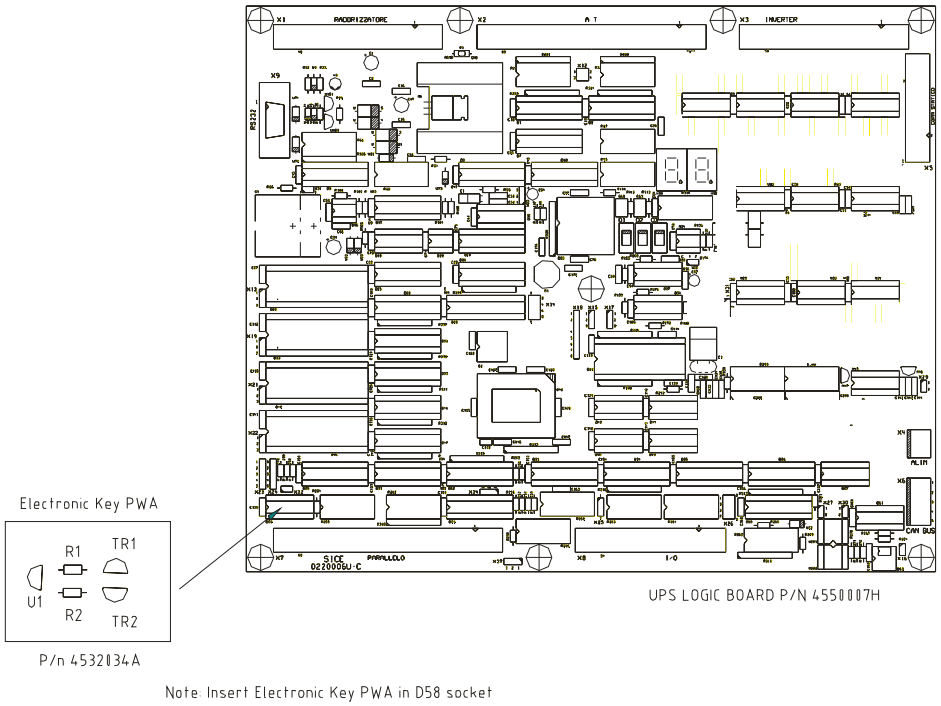


Figure 7-5 – Optional electronic key

7.13 XTreme PF Load (XTR 0.9 and 1.0)

XTreme PF kit allows working at 100% real power rating even with different Leading PF loads (capacitive).
The hardware output filter modifications and the dedicated FW provide to the best performance.
The data in the Specification of this manual are referred to PF 0.8. Refer to Marketing Technical Specification for option XTreme PF 0.9 and 1.0.

7.14 Optional Shipping Air kit

This optional kit is used to secure the heavy magnetic parts inside UPS during shipment by airplane.
Before the equipment is in place, remove the transportation restraints.

7.15 RS232 communications

This section gives a brief outline of external communication options available for the Liebert Hipulse E UPS.

7.15.1 RS232 communication kit

It is possible to implement local or remote RS-232 communications between the Liebert Hipulse E UPS system and a Personal Computer (PC) using a purpose-designed communications kit.
An RS232 (X8) connector is fitted on the Operator Logic Board as standard on all UPS systems to allow remote interfacing of the UPS front panel control and indication functions.
The optional RS232 communication kit allows to transfer some information available from the UPS display system and converts it into a customer-usable form for local or remote display.

When installed, the communications kit enables the following functions to be carried out from the PC terminal:

- Set and modify the UPS system parameters.
- Monitor the UPS alarms status, and provide an alarms history if required.
- Monitor system analogue parameters (voltage, current, frequency, power, temperature).
- Activate UPS commands (set date/time, ON-OFF of rectifier / inverter / bypass, etc.).
- Detect UPS communications set-up (node configuration).

Local operation is achieved by connecting a personal computer (PC) directly to the UPS module via an RS-232 cable of up to 15m length. For communication over greater distances a pair of modems are required to provide the necessary interface with the Public Telephone Service Network (PTSN).

The UPS control system is ready-prepared for external communications via connectors X9 and X8 on its Operator Logic Board (located back on the front door): connector X9 and X8 provide an RS-232 Interface.
The hardware includes a male connector fixed on the aluminium panel fitted to the lower left-hand region of the module (under the auxiliary terminal block) which is connected to the Operator Logic Board (via X8). The output connector (X9 on the aluminium panel) is then connected to the PC for a local installation or to a modem in a remote installation. The X9 connector is a 25 pin D-type male connector (D-25) with a standard RS-232 pin out.

7.15.2 Modem

Using a modem, Liebert Hipulse E is able to transmit the status of the UPS to a remote location over a telephone line. For this purpose, space has been left on the inner side of the UPS door. The modem should be connected to the RS232 (X8) on the Operator Logic Board. The modem power supply may be derived from the 250Vac max supply inside the UPS (the power cable should be supplied with modem). The telephone line should be secured in the cable passage shown in the figure in Chapter 6.

7.15.3 Communication kit – installation with several modules

It is possible to use the communications kit to monitor and control up to eight UPS modules. Such modules may be configured as independent Single module systems, 1+N systems, or Multimodule.

From a hardware viewpoint, when two (or more) modules are connected to the communications system only one module is connected to the PC/Modem via the Communications Interface Board - this is classed as the master module. The remaining modules, which are classified as slave modules, are daisy-chained to the master module via an 3 poles connector X4 input and X5 output of the Operator Logic Board, as shown figure below, thus the control and operational data for each module is transmitted through the communication link to the P.C. via the master module. Note that the connectors (X4&5) are the female 3-pin.

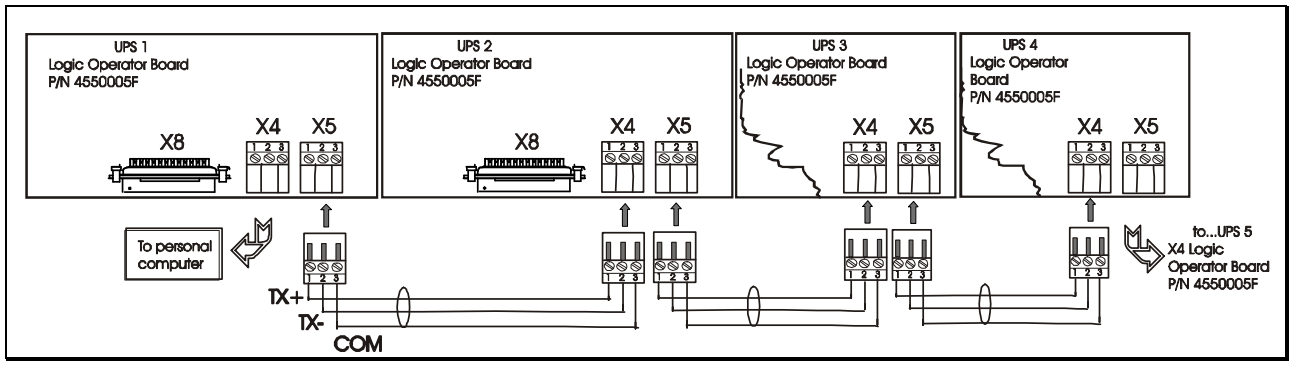


Figure 7-6 – RS485 connections

7.15.4 NIC (Network Interface Card)

The Liebert Network Interface Card (NIC) provides Ethernet connectivity for your Liebert UPS equipment.
The card allows monitoring the operating status, and communication of alarms via the network.
The NIC transforms Liebert units into intelligent managed nodes in your network, enabling in-band communications with network management systems (NMS) that monitor the well-being of your computing/communication infrastructure.
This protocol allows simple integration into the network management system, thus leveraging prior investment and established procedures.
The NIC may be ordered as a factory-installed option, or in a kit for field-retrofit to existing Liebert UPS units.

7.15.4.1 Connection with UPS

- Connection with UPS systems is through Ethernet 10BaseT connection
- A compatible Network Card Adapter (10BaseT or similar) will have to be fitted on the PC
- Connection can be provided through a standard Network Hub or Switch, or through a direct cable connection

A serial connector is available on the OpenComms NIC to allow configuration of card parameters (IP Address, SNMP community name and SNMP station configuration) as well as for firmware updates.
The Ethernet line should be secured in the cable passage shown in the figure in Chapter 6.

7.15.4.2 Information provided with the SNMP protocol

The NIC SNMP interface provides information on the following 6 groups: Identification, Battery, Input, Output, Bypass and Configuration.

7.15.5 Modbus/Jbus

Modbus is a field standard introduced in 1979 by Modicon. Modbus works on a "master/slave" protocol using a non-powered two-wire (RS485) network. The controlling software, normally the BMS itself, will be the 'Modbus master', allowing control of up to 247 slave addresses: in practice, typical implementations will support up to 32 nodes per RS485 port.
Building Management Systems (BMS) are sophisticated programs that help facility managers and technicians monitor and control temperature and ventilation conditions, security and fire safety, power distribution systems as well as power supply systems - like UPS units - in non-residential buildings.The Modbus/Jbus option is installed within Liebert Hipulse E UPS by replacing a programmable component - namely an EPROM - on the UPS Logic Board. The Logic Board is normally fitted with a component that allows communication via the standard IGMnet protocol - the protocol used to get information from the UPS via the serial connector - when this is removed, in order to fit the Modbus/Jbus option, it will not be possible to use the SNMP card (OpenComms NIC).

Jbus

Jbus is a subset of Modbus, generally identified as the "French" version of Modbus, because it was originally developed in France. Conversion between the two protocols (Modbus and Jbus) is straightforward and it should always be possible to use them interchangeably.
The UPS is not programmed to use the MODBUS protocol and must be configured from the UPS operator panel menu.

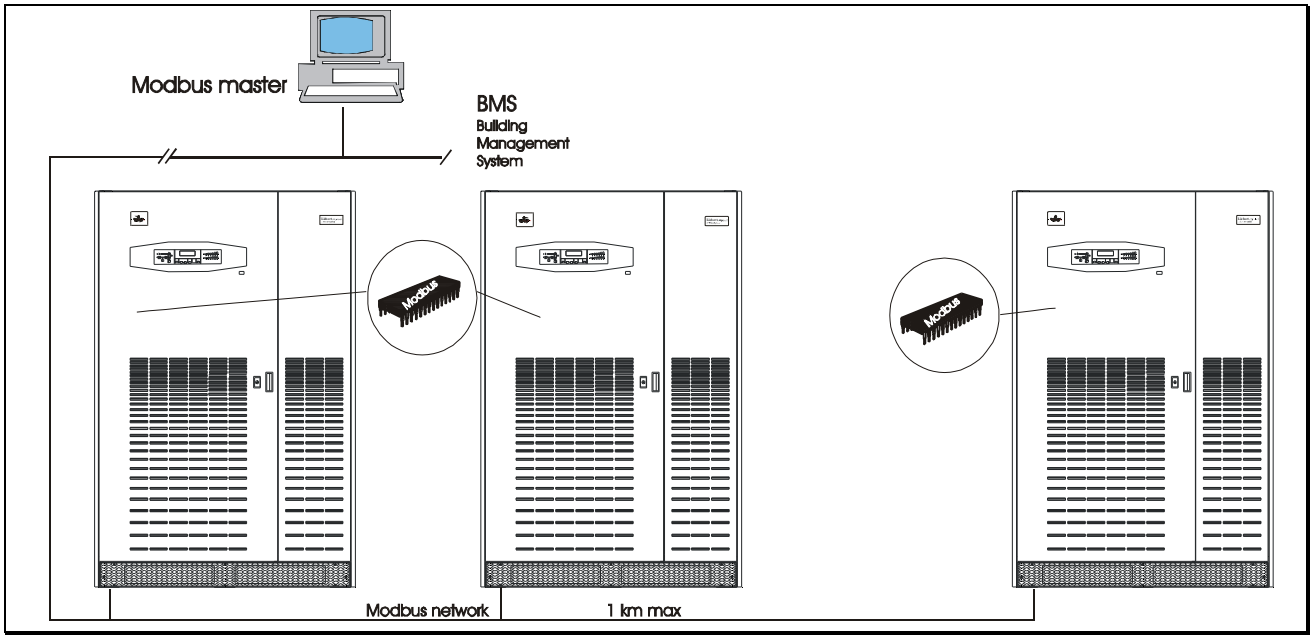


Figure 7-7 – Modmobus network

7.15.6 Remote control panel

The Remote Alarm Monitor (RAM) (P/N 4305003B) may be used to view the principal signals, alarms, and warnings relating to UPS status from a distance (up to 1 km). It can be connected up to six UPS via RS-485 serial interface. An audible warning accompanies the above alarm conditions and it can be cancelled by pressing the "reset" push-button, while the alarm indication will remain illuminated until the condition is rectified. This type of Operator Interface can be divided in three functional areas:

- LCD Display, equipped with a 4x20 character alphanumeric display, which automatically provides information relating to your system and metered values current status. The display is menu driven, permitting you to easily navigate through operator screens.
- • System alarm LED, (left side) representing the main information about your system status.
- • System apparatus LED, (right side) representing the main information about your connected apparatus status.

7.15.6.1 Technical features of the remote alarm monitor

The principal technical features are:

Dimensions (LxDxH)	230x192x70 mm
Weight	about 1 Kg
Colour	RAL 7035
Remote Alarm Monitor power supply	from X22 socket through power supply unit output
Power supply unit (supplied)	Input: 220\240 Vac — 50\60 Hz
	Output: 24 Vdc
Absorbed power	about 6 VA
Installation	Horizontal (desktop)
	Vertical (wall-mounted)
Serial interface	RS232 DTE (X8)
" "	RS485 (X21)

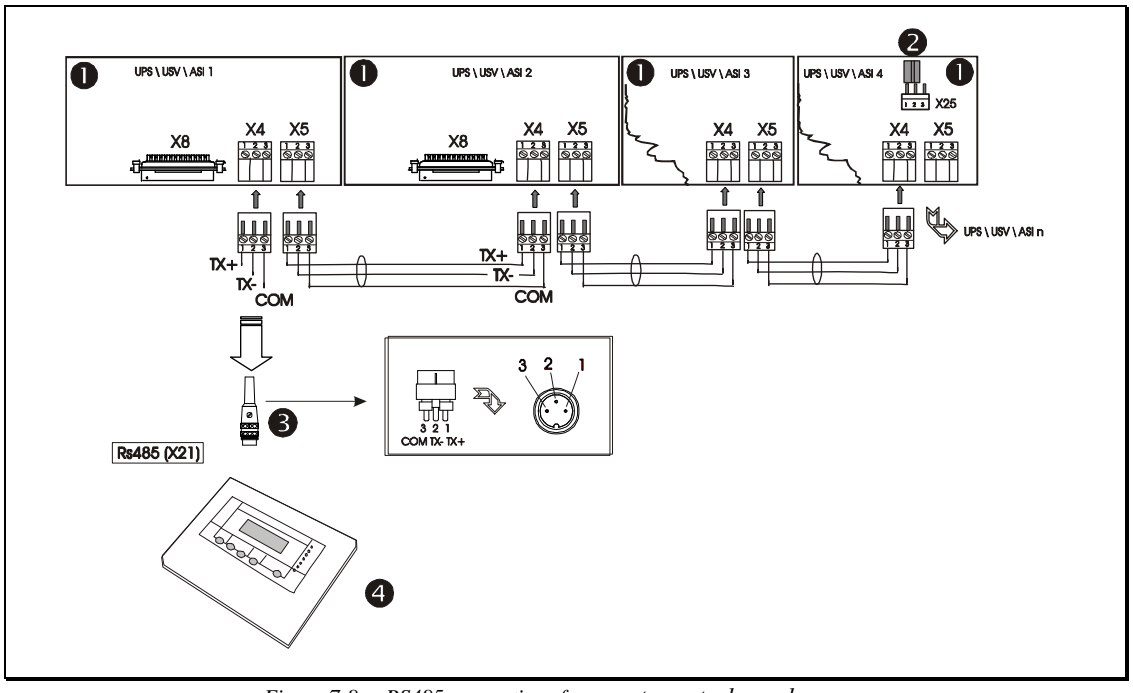


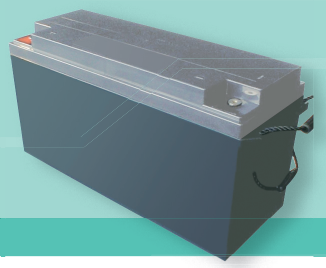
Figure 7-8 – RS485 connections for remote control panel

	Legend
❶	Operator Logic board (P/N 4550005F)
❷	Jumper
❸	Loose plug for RS485 connection
❹	Remote control panel

WETAC

WING

ESL 150-12



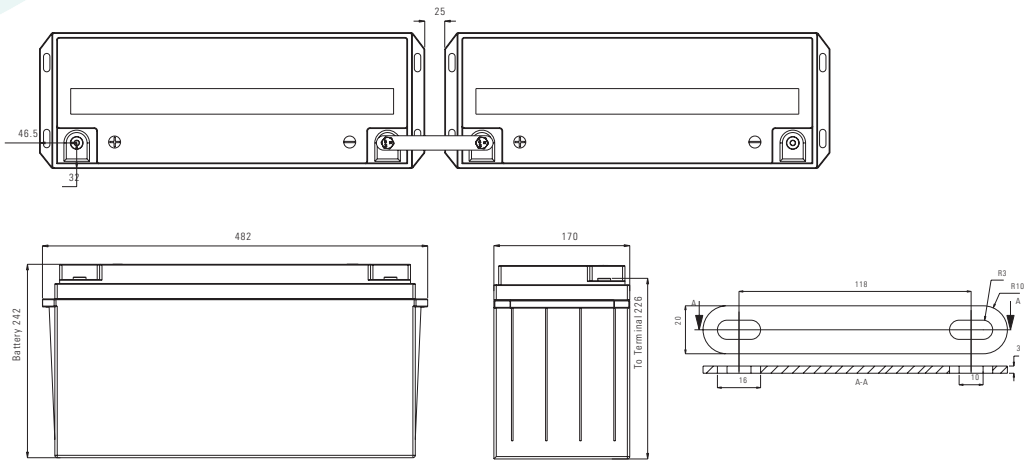
Innovative Features

- Completely maintenance free, sealed construction eliminates the need for watering
- Fully tank formed plates
- Analytical Grade electrolyte
- Spill proof / leak proof
- Valve regulated Max internal pressure 2.5 psi
- Multi-position usage
- ABS Case and cover - V0 on request
- Low self discharge
- FAA and IATA approved as non-hazardous
- Built to comply with IEC 8962, DIN 43534, BS 6290 Pt4, Eurobat

Specifications

- Nominal Voltage.....12 Volts
- Nominal Capacity .....150Ah (C20 @ 20 °C)
- Design Life .....12 Years
- Operating Temperature....-20 °C to 50 °C
- Grid alloy.....Calcium / Tin lead alloy
- Plates.....Flat Pasted
- Separator.....Absorbant Glass Mat
- Active material.....Very high purity lead
- Case and cover.....ABS (VO on request)
- Charge Voltage .....Float 2.25 - 2.30 VPC @25 °C
  Cycling 2.35 @25 °C
  Max. 2.4 VPC Max ripple 0.05C (A)
- Electrolyte .....Sulphuric acid Analytical grade purity
- Venting Valve .....EPDM Rubber 1.5 to 2 psi (10.5 - 14 KPa) release pressure. Resealing at 1 psi (7 KPa)
- Terminal.....Insert 14mm Dia M6 thread. Epoxy sealed by extended mechanical paths
- Torque setting.....The recommended torque value for all types is 5-7 Nm
- Cables.....Connectors, cables, terminal covers on request.

Terminal Dimensions



Specifications

Nominal Voltage	12V		
Nominal Capacity	150 Ah		
Dimensions	Total Height - (Inc. terminal s) Length - Width	242 mm - n/a mm 482 mm - 170 mm	9,53 inches - n/a inches 18,98 inches - 6,69 inches
	Weight 44,2 Kg - 97,68 lbs		

Characteristics

Capacity 20 °C (68 °F) To 1.7 volts	20 hour rate 10 hour rate 5 hour rate 1 hour rate 15 min rate Internal Resis tance Impedance	148,9 Ah 132,2 Ah 118,3 Ah 103,6 Ah 66,7 Ah 2,5 mOhms S
Capacity correction for Temperature Variations (C20)	40 °C (104 °F) 20 °C (68 °F) 0 °C (32 °F) -15 °C (5 °F)	102% 100% 85% 65%
Self-Discharge 20 °C (68 °F)	Capacity after 1 months storage Capacity after 3 months storage Capacity after 6 months storage	98% 94% 86%
Short Circuit Current 20 °C (68 °F)	4200	
Terminal	Standard Optional	14mm Insert M6 thread Cu/Lead Flag - J Type - Auto
Charging (Constant Voltage)	Cyclic Float	2.35 - 2.40 VPC (20-25 °C) 2.27 - 2.30 VPC (15-25 °C)

Constant Power Discharge - Watts per Cell at 20°C

End V per Cell	5M	10M	15M	20M	25M	30M	35M	40M	45M	60M	90M	2 hr	3 hr	4 hr
1.85	529	460	394	350	314	287	260	239	220	179	131	101	69.1	53.3
1.80	652	523	438	381	339	306	277	255	234	189	133	103	70.3	54.1
1.75	706	565	465	401	355	319	289	264	242	193	134	103	70.7	54.1
1.70	751	594	485	415	364	326	295	269	246	196	137	106	71.8	55.7
1.65	778	622	506	428	372	332	300	273	250	198	139	106	72.1	-
1.60	810	636	515	436	377	337	304	276	252	200	140	107	72.3	-

Constant Amps discharge - Amps at 20°C

End V per Cell	5 M	10 M	15 M	20 M	25 M	30 M	35 M	40 M	45 M	60 M	90 M	2 hr	3 hr	4 hr	5 hr	8 hr	10 hr	12 hr	20 hr
1.85	284	246	210	186	166	152	137	126	115	93.3	68.0	52.2	35.4	27.2	22.3	15.0	12.4	10.6	6.94
1.80	356	284	237	205	182	163	147	135	123	99.4	69.4	53.5	36.2	27.8	22.8	15.4	12.8	10.9	7.20
1.75	389	310	254	217	191	171	154	141	128	102	70.1	53.9	36.5	27.9	23.0	15.5	12.9	10.9	7.27
1.70	418	329	267	227	198	176	158	144	131	104	72.0	55.2	37.2	28.8	23.7	16.0	13.2	11.3	7.44
1.65	435	346	279	235	203	180	162	147	133	105	72.9	55.5	37.4	-	-	-	-	-	-
1.60	455	355	285	239	206	183	164	148	135	106	73.7	56.0	37.6	-	-	-	-	-	-

Ampere Hour at 20 °C

End V per Cell	2 hr	3 hr	4 hr	5 hr	8 hr	10 hr	12 hr	20 hr
1.85	104	106	109	111	120	124	127	139
1.80	107	109	111	114	123	128	130	144
1.75	108	110	111	115	124	129	131	145
1.70	110	112	115	118	128	132	135	149
1.65	111	112	-	-	-	-	-	-
1.60	112	113	-	-	-	-	-	-

Wetac keenly encourages environmental awareness;
PLEASE follow guidelines for the recycling / disposal of lead.

Pb

OPERATIONS AND MAINTENANCE MANUAL

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SECTION 4

Planned Maintenance Instructions

Contents

Planned Maintenance Details

Due to specialist nature of equipment a service contract is recommended. This ensures the equipment is maintained by factory trained service personal.

Please contact Emerson Network Power's Service Sales team for any further information.

Stephanie Dean – UPS Sales
Tel: 01628 403233
Mobile: 07710 011752
Fax: 01628 403279
Email: stephanie.dean@emerson.com

Mark Vojkovic -Contracts Sales Manager Service - UPS
Tel: 01628 403268
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OPERATIONS AND MAINTENANCE MANUAL

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SECTION 5

HEALTH AND SAFETY

5.1 HipulseE UPS

5.1.1 HipulseE UPS Equipment Safety
5.1.2 Waste Management
5.1.3 COSHH Regulations

5.1 Batteries

5.2.1 Battery Safety
5.2.2 VLRA Battery COSSH Assessment

5.1.1 HipulseE UPS Equipment Safety

The following is to be used as a guideline when working on UPS equipment.

The HipulseE UPS has been designed for Commercial/Industrial use only, and is not recommended for use in life support applications.

This equipment complies with the following requirements:
Normative references: Uninterruptible Power System (UPS).
* IEC 62040-1-1 (2002) — 'General and safety requirements for use in operator access area';
* EN 50091-2 (1995) — 'EMC requirements';
* IEC 62040-3 (2001) — 'Performance requirements and test methods';
* EN 60950 (2001) — 'Information technology equipment;
* EN 60529 (1989) — 'Degrees of Protection provided by enclosures (IP Code) and published technical standards. For more details, see Chapter 5 'Conformity and standards'.
Continued compliance requires installation in accordance with these instructions and the use of manufacturer approved accessories only.

WARNING
HIGH EARTH LEAKAGE CURRENT: EARTH CONNECTION IS ESSENTIAL BEFORE CONNECTING THE INPUT SUPPLY.
This equipment must be earthed in accordance with local electrical authority codes of practise.

Caution
This equipment can be fitted with RFI suppression filters (optional).
Earth leakage current exceeds 3.5 mA and is less than 1000 mA.
Transient and steady-state earth leakage currents, which may occur when starting the equipment, should be taken into account when selecting instantaneous RCCB or RCD devices.
Residual Current Circuit Breakers (RCCBs) must be selected sensitive to DC unidirectional pulses (class A) and insensitive to transient current pulses.
Note also that the earth leakage currents of the load will be carried by this RCCB or RCD.

WARNING
This system has a signal available for use with an automatic device, externally located, to protect against backfeeding voltage through the mains Static Bypass circuit. If this protection is not used with the switchgear that is used to isolate the bypass circuit, a label must be added at the switchgear to advise service personnel that the circuit is connected to a UPS system.
The text is the following or equivalent:
ISOLATE THE UNINTERRUPTIBLE POWER SYSTEM
BEFORE WORKING ON THIS CIRCUIT.

General
As with other types of high power equipment, dangerous voltages are present within the UPS and battery enclosure. The risk of contact with these voltages is minimized as the live component parts are housed behind a hinged, lockable door. Further internal safety screens make the equipment protected to IP20 standards.
No risk exists to any personnel when operating the equipment in the normal manner, following the recommended operating procedures.
All equipment maintenance and servicing procedures involve internal access and should be carried out only by trained personnel.

Batteries
Battery manufacturers supply details of the necessary precautions to be observed when working on, or in the vicinity of, a large bank of battery cells. These precautions should be followed implicitly at all times.
Particular attention should be paid to the recommendations concerning local environmental conditions and the provision of protective clothing, first aid and fire-fighting facilities.

WARNING
Follow these instructions scrupulously:
The Liebert HipulseE is designed exclusively for indoor use. Protect the unit from excessive condensation and install it in a place free of flammable liquids, gases and corrosive substances.
Electrical installation must be performed by a qualified electrician.
Personnel working with the equipment described in this manual must be thoroughly familiar with the product.
Before making connections inside the unit, make sure that all incoming power sources are de-energised and insulated.
When the incoming power source is active, the unit contains a dangerous level of voltage, even when it has “maintenance bypass” status.
To insulate the unit, turn it off and insulate all incoming power sources and auxiliary power sources.

Electrical Safety
Under no circumstances must unqualified persons interfere with electrical supply or equipment. All appliances and electrical work must comply with The Electricity at Work Regulations 1989 and the British Standard 7671:1992 “The Requirements for Electrical Installations”. When working on electrical equipment or wiring, the supply must be SWITCHED and LOCKED off. Suitable arrangements must be made at the breaker to ensure that the power is not reconnected until safe to do so.

Isolation procedure
When a part of an electrical system is to be made dead, all incoming supplies, including possible backfeeds and DC supplies, must be isolated before work begins.
Before any circuits are isolated, a clear understanding must be established with the site occupier/client as appropriate on the premises, of the work to be carried out to determine the means of isolation to be employed.

Many circuits can be simply and effectively isolated by locking a disconnector into the 'OFF' position and applying a 'Warning' notice that the system is being worked on.

Some electrical circuits are necessarily complex because the existence of power, control, indications and alarm circuits demand the provision of different systems.
In some cases the means of isolation will be numerous and not at a point adjacent to the proposed work.
Confirmatory voltage detection tests then assume key importance and the tests should ensure that the system is safe to work on.
Such tests carried out in accordance with good practice may not require accompanied working.

The person carrying out isolation(s) of the circuits(s) must adhere strictly to the following procedures: -

Understand the scope and limits of the work to be carried out.
Identify all means of electrical isolation by reference, where possible, to installation drawings (titles applied to the labelling of all equipment should relate to the drawings of the electrical system and the connected plant)
Carry out check-tests in all circumstances for the absence of voltage following isolation of equipment, except where portable/transportable equipment is visibly disconnected by the removal of a plug from a power socket.

Means of isolation

i) Switch fuses and Fuse switches) Lock In the "OFF" position if possible: Alternatively, withdraw fuses and post "Warning" notices.

ii) Other disconnectors or circuit breakers must be locked in the "OFF" position.

Persons not involved in the work, particularly those who are not electrically competent, should be kept away from the immediate working area. Equipment with the covers removed and containing live parts must not be left unattended. Covers to all electrical equipment must be replaced when the work has been completed and before the supply is turned on.

Where practicable, all points of isolation shall be Locked Off.

Important - Isolation is a means of ensuring that the supply will remain switched OFF and inadvertent reconnection prevented. To assist in achieving this, a Permit to Work system must be considered at all times.

5.1.2 Waste Management

It is the Company's policy to comply with the requirements of the Environmental Protection Act 1990, including the Environmental Protection (Duty of Care) Regulations 1991, the Controlled Waste (Registration of Carriers and Seizure of Vehicles) Regulations 1991, the Special Waste Regulations 1996 and the accompanying "Waste Management, the Duty of Care - A Code of Practice" when carrying and/or disposing of waste generated by our work activities.

5.1.3 COSHH Regulations

The Company is required to control all substances that are hazardous to health

Substances likely to cause a hazard to health are assessed and the data sheets and risk assessment are contained in the COSHH manual, held by the Health & Safety Co-ordinator.

These regulations require an employer to make a suitable and sufficient assessment of the risks from hazardous substances created by work and sets out the steps that need to be taken to meet the requirements of the regulations in order to prevent the exposure of employees to the hazardous substance or if this is not reasonably practicable to adequately control these substances.

5.2.1 Battery Safety

Battery location
Temperature is a major factor in determining the battery life and capacity. Battery manufacturers quote figures for an operating temperature of 20°C. Operating above this temperature will reduce the battery life; operation below this temperature will reduce the battery capacity. Typically the battery temperature should be maintained between 15°C and 25°C. Batteries should be mounted in an environment where the temperature is consistent and even over the whole battery. Keep batteries away from main heat sources or main air inlets etc.
Never install batteries in a gas-tight enclosure as gases may be generated during use. Batteries must always be charged on a voltage-regulated charging system and adequate ventilation provided to avoid the build-up of ignitable gases.

The battery is connected to the d.c. busbar through a circuit breaker fitted inside the Battery Circuit Breaker Cabinet, which is located within the battery room. This isolator is closed manually, but it contains an undervoltage release coil which enables it to be tripped from the UPS control electronics following certain detected faults. It also has a magnetic trip facility for overload protection. The thermal protection is provided by two fuses in parallel for each polarity.

Safety
Special care should be taken when working with the batteries associated with the UPS System equipment. When all the cells are connected together, the battery terminal voltage will exceed 400V and is potentially lethal. A primary safety consideration is to physically isolate the battery installation from all but appropriately qualified maintenance personnel. Emerson Network Power Ltd trained personnel must only carry out any maintenance or checks.

Batteries
The following is to be used as a guideline when working with batteries.

Installation and servicing of batteries should be performed by personnel knowledgeable of batteries and the required precautions. Potentially lethal voltages exist within the equipment during operation. Observe all cautions and warnings in Installation, Operation and Maintenance Manuals. Failure to do so could result in serious injury or death. Unauthorised personnel must be kept away from batteries.

The battery system presents a risk of electrical shock and high short circuit current.

A typical battery system could have a terminal voltage exceeding 400 Volts DC and short circuit current capacity of many thousand amperes. For parallel strings the short circuit current is the sum of that of the individual strings.

The following precautions should be observed when working on batteries:

- Remove watches, rings and other metal objects.
- Use tools with insulated handles.
- Use insulated mat.
- Wear high voltage insulating gloves.
- Do not lay tools or metal parts on top of batteries.
- Wear proper eye protection.

Determine if the battery is inadvertently grounded by measuring the voltage between the battery and the support tack or enclosing cabinet. This voltage should be zero (0). If the measured voltage is not zero, determine and remove the cause.
Verify circuit polarities as correct prior to making connections.
Disconnect charging source and load prior to connecting or disconnecting terminals.

Fire Hazards and Personal Safety
Batteries can contain an explosive mixture of hydrogen gas. The following procedures should be followed:

- Do not smoke when near batteries.
- Do not cause flame or spark in battery area.
- Discharge static electricity from body before touching batteries.
- Do not open or mutilate batteries.
- Do not dispose of battery in fire - the battery may explode.

Handling
Batteries are heavy. Use care when moving or lifting batteries to avoid physical injury.

Disposal
All batteries must be disposed of through an approved licensed disposal contractor.

Wetac International

Material Safety Data Sheet

Data Sheet No: VRLA AGM Issue 4

Date Issued: October 28th, 2005

1 Identification of the substance

Product name: Valve Regulated Lead Acid, Absorbed Glass Mat Battery

Trade name: Lead acid battery WING

E mail: info@wetac.nl
Tel: +31 (0)318-696190
Fax: +31 (0)318-696191
Responsible persons: QA Representative, Managing Director

2 Composition / Ingredient Data

Hazardous Components Chemical Identity	CAS Number	OSHA PEL	ACGIH TLV	Percent By Weight	EC Number	Average
Lead	7439-92-1	50 µg/m^3	50 µg/m^3	45-55%	231-100-4	50%
Sulfuric Acid	7664-93-9	100 µg/m^3	1.00 mg/m^3	19-25%	231-639-5	22%
Lead Oxide	1309-60-0	50 µg/m^3	500 µg/m^3	19-23%	215-174-5	21%

	Risk Phrases	Safety Phrases
Sulphuric Acid	R61,62,20/22,33	S1/2,S26,S30,S45
Lead Oxide	R35	None

3 Hazards Identification

Odour: Not applicable
Appearance: Article as described above
Weight High Density/ Good lifting technique required

Hazards refer to internal component, i.e. lead and sulphuric acid
Contact with eyes: Causes irritation
Contact with skin: May cause dermatitis
Inhalation: May cause irritation
Ingestion: Can cause damage to the kidneys

4 First Aid Measures

Contact with skin: Remove contaminated clothing immediately and drench affected skin with plenty of water, then wash with soap and water.

Contact with eyes: If substance has got into eyes, immediately wash out with plenty of water for at least 15 minutes.

Seek immediate medical attention.

Ingestion: Do not induce vomiting.

Seek immediate medical attention.

Inhalation: Remove patient to fresh air.
Seek medical attention if irritation persists.

5 Fire-Fighting Measures

Auto-ignition point (Hydrogen) 580º C at 760 mm Hg
Wear positive-pressure breathing apparatus
In case of fire use foam, carbon dioxide or dry agent (S43)
Flash point Hydrogen 259º C
Flammable Limits in air, Lower 4.1%
% by 3/4 vol. (Hydrogen)

Fire / explosion
Hydrogen and oxygen gases are produced in the cells during normal battery operation (hydrogen is flammable and oxygen supports combustion).

6 Accidental Release Measures

Immediate Actions: Shut off all ignition sources
Clean Up Actions: Neutralise with soda ash
Place in appropriate container
Ventilate area
Do not empty into drains (S29)

7 Handling and Storage

Under normal conditions of battery use, internal components will not present a health hazard

Handling: Keep away from heat and sources of ignition
Wash hands thoroughly after use
Avoid sparks
Avoid contact with metal jewellery and watches etc.
Do Not Remove Vent Caps
Do not double stack industrial batteries, it may cause damage.

Storage: Keep in cool and dry & Protect from heat.
Store lead acid batteries with adequate ventilation.
Room ventilation is required for batteries utilised for standby power generation.
Never re-charge batteries in an unventilated, enclosed space.

8 Exposure Controls / Personal Protection

Personal protection: Wear safety shoes with toe protector.
Where internal components are liberated use rubber or neoprene boots.
Wear goggles/safety glasses giving complete eye protection.
Respiratory protection may be required under exceptional circumstances when excessive air contamination exists.
Wear PVC mitts, gloves or gauntlets.

Exposure Limits: Lead OES / LTEL - ppm 0.15 mg/m3
Lead Dioxide OES / LTEL - pmm 0.15 mg/m3

9 Physical and Chemical Properties

Odour:	Not applicable.
Appearance:	Sealed Valve Regulated lead Acid Battery
State under normal temp:	Solid
Flash point (Hydrogen):	259º C

Internal components

pH - (Sulphuric acid):	1.3 .
Boiling point: (at 760 mm/Hg)	Battery Electrolyte 110º C, Lead 1755º C
Melting point:	Lead 327.4º C
Vapour pressure:	11.7
Vapour density:	Battery Electrolyte 3.4, (air =1)
Specific gravity:	Battery Electrolyte 1.3 g/cm3. (water =1)
Auto-ignition point:	580º deg C at 760 mm/Hg.
Water solubility:	Battery Electrolyte is 100% soluble in water

10 Stability and Reactivity

VRLA Batteries are considered stable at normal conditions.
Keep away from heat and sources of ignition.
Incompatible with reducing agents. Incompatible with organic agents.
Decomposition products may include hydrogen.
Decomposition products may include sulphur oxides.

11 Toxicological Information

Danger of cumulative effects. (R33)
May cause severe irritation.
May cause gastro-intestinal disturbances.
Can cause damage to the mucous membranes.

12 Ecological Information

Ecotoxicology - no information available

13 Disposal Considerations

Classification:	This material and/or its container must be disposed of as hazardous waste.
Disposal considerations:	Do not discharge into drains or the environment, dispose to an authorised waste collection point.

14 Transport Information

We hereby certify that the Wetac International range of Maintenance Free Rechargeable Sealed Lead Acid batteries conform to the UN2800 classification as " Batteries, Non- Spillable, and electric storage" as a result of passing the Vibration and Pressure Differential Test described in DOT [49 CFR 173.159(d) and IATA/ICAO [Special Provision A67].

Wetac International having met the related conditions are EXEMPT from hazardous goods regulations for the purpose of transportation by DOT, and IATA/ICAO, and therefore are unrestricted for transportation by any means.

15 Regulatory information

Classification and labeling. Not classified as hazardous for supply

16 Other Information

Under normal conditions of battery use, internal components will not present a health hazard. The information contained in this Safety Data Sheet is provided for battery electrolyte (acid) and lead, for exposure that may occur during battery production or container breakage or under extreme heat conditions such as fire.
Tested as per IMDG Amdt. 31-02, special provision 238 "a" and "b", Comply.

This Safety Data Sheet and the information therein does not constitute the user's own assessment of work place risk as required by other Health & Safety legislation.

OPERATIONS AND MAINTENANCE MANUAL

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SECTION 6

DIRECTORY OF MANUFACTURERS, AND COMPONENT SUPPLIERS

Contents

Directory of Suppliers

DIRECTORY OF MANUFACTURERS, COMPONENT SUPPLIERS AND SUB CONTRACTORS

Company Name	**Address**	**ITEM/SERVICE SUPPLIED**	**Telephone**	**Fax**
Emerson Network Power	Fourth Avenue Globe Park, Marlow Buckinghamshire SL7 1YG	HipulseE 400kVA UPS	+44 (0)1628 403 200	+44 (0)1628 403 294
Mercer Holdings	Unit 11, Bath Road Business Centre, Devizes, Wiltshire, SN10 1XA	Battery Build / DC Cabling	+44 (0) 1380 726777	+44 (0) 1380 725906
WETAC UK	WETAC UK LTD Office 17, Bolton Business Centre, 44-46 Lower Bridgeman Street Bolton, BL2 1DG	ESL150-12 Batteries / Cladded Stands	+44 (0) 1204 366728	+44 (0) 5601 252674

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SECTION 7

Emergency Contacts

Emerson Network Power
Emergency Contacts (**Maintenance Contract Customers Only**)

Phone 0800 181823

OPERATIONS AND MAINTENANCE MANUAL

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SECTION 8

SCHEDULE OF TESTING / COMMISSIONING RESULTS

Contents

8.1 Commissioning Results

8.1.1 Commissioning Reports
8.1.2 Level C Test Reports

T-Mobile, Beckton Hipulse-E 400KVA UPS Module 1

START UP RECORD

Site ID		Unit Type	12P 400KVA Single	Site Name	T-Mobile
Tag N°		Serial N°	90009302	Engineer	A.Costello
Ticket N°		Module N°	1	Date	20 April 2010

SECTION 1 INSTALLATION CHECKS

Unit Position	Y
Unit Mechanical	Y
Input Cables (Including Earth)	Y
Bypass Cables (if fitted	Y
Battery Cables	Y
Battery CB Control Cables	Y
Output Cables	Y
Remote Connections	Y

SECTION 2 PCB LINKS SETTINGS

Rectifier Logic Board	Y
Inverter Logic Board	Y
UPS Logic Board	Y
Operator Logic Board	Y
High Voltage Board	Y
DC-DC Power Supply Board	Y
O/P Static Switch Trigger Board	Y

SECTION 3 PRE-POWER CHECKS

T1/T2 Transformer Tapping	Y

SECTION 4 SOFTWARE COMMISSIONING

Software Version	UPS Logic	V. 22.5	
	Panel	V. 22.3	

4.1 LANGUAGE SELECTION

Language (Enter Selection)	ENG	

4.2 FUNCTION PARAMETERS

Battery Test	Now	N	Y/N
	Automatic	N	Y/N
Set Up	Duration	1	Mins
	Threshold	1.70	Volts
	Period	0	Days
Start Up	Date	20/04/2010	Hr
	Time	16:00	Hrs

Generator		
Sync Inhibit	N	Y/N
Boost Inhibit	N	Y/N
Reduce I/P Current Limit	N	Y/N

Panel Set Up	
Type	1
Group	1
Password	000000

4.3 MAINTENANCE PARAMETERS

Set Time	15:00
Set Date	20/04/2010
Set Serial Number	90009302

4.4 SETUP PARAMETERS

Voltage	Rated Voltage	415	V
	Input +	10	%
	Input -	10	%
	Output +	10	%
	output -	10	%
Frequency	Nominal	50	Hz
	Sync Window	2	%
	Speed	0.1	Hz/S
Battery	Number/Cells	204	
	Capacity	450	Ah
Battery Voltage	EOD	340.68	V
	Low Battery	371.28	V
	Maximum	499.8	V
Battery Boost	Enable	N	Y/N
	Automatic	N	Y/N
	Duration	0	Mins
	Threshold	0	Volts

SECTION 5 HARDWARE COMMISSIONING

5.1 RECTIFIER SETUP

Voltage Level	Manual	460	V
	Float	460	V
	Boost	460	V
	Test	460	V
Battery CB Operation		Y	
Battery Current Limit		45	A
I/P Current Limit @TP X8 pin 7		-2	V

5.2 INVERTER SETUP

R - N			240	V
S - N			240	V
T - N			240	V
Bypass Sync			Y	

5.3 AUXILIARY ITEMS CHECK

Transfer Inverter to Bypass			Y	
Transfer Bypass to Inverter			Y	
DC Bus Ripple			0.47	V ac
I/P Filter I	52.4 A	52.6 A	51.5 A	
AC - DC PSB Check			Y	
DC - DC PSB Check			Y	
Fan Operation			Y	
Battery CB Operation			Y	
Output Filter I	122 A	122 A	122 A	

HIPULSE
STARTUP RECORD

Unit Type	Hipulse E
Serial No / Module No	90009301
Engineer	I BELL

Supply (V/Hz)	400 / 50
Customer	T MOBILE
Date	24/05/2010

SECTION 1 INSTALLATION CHECKS

Unit Position	√	√ / X
Unit Mechanical	√	√ / X
Input Cables (Including Earth)	√	√ / X
Bypass Cables (if fitted)	√	√ / X
Battery Cables	√	√ / X
Battery CB Control Cables	√	√ / X
Output Cables	√	√ / X
Remote Connections	x	√ / X

SECTION 2 PCB LINK SETTINGS

Rectifier Logic Board	√	√ / X
Inverter Logic Board	√	√ / X
UPS Logic Board	√	√ / X
Operator Logic Board	√	√ / X
High Voltage Board	√	√ / X
DC-DC Power Supply Board	√	√ / X
Static Switch Trigger Board	√	√ / X

SECTION 3 PRE-POWER CHECKS

T2/T3 Transformer Tapping	√	√ / X

SECTION 4 SOFTWARE COMMISSIONING

Software Version UPS Logic	22.5
Software Version Panel	22.3

4.1 LANGUAGE SELECTION

Language (Enter Selection)	Eng	(ENG)

4.2 FUNCTION PARAMETERS

Battery Test	Now	N	Y/N
	Automatic	N	Y/N
Setup	Duration	5	M
	Threshold	1.9	V
	Period	1D	M
Startup	Date	######	Hr
	Time	00:00	M

Generator		
Sync Inhibit	N	Y/N
Boost Inhibit	N	Y/N
Reduce I/P Current Limit	N	Y/N

Panel Setup	
Type	1
Group	1
Password	000000

4.3 MAINTENANCE PARAMETERS		
Set Time	√	√ / X
Set Date	√	√ / X
Set Serial Number	90009301	

4.4 SETUP PARAMETERS

Voltage	Rated V	400	V
	Input +	10	%
	Input -	10	%
	Output +	10	%
	Output -	10	%
Frequency	Nominal	50	Hz
	Sync Window	2	%
	Speed	0.2	Hz/S
Battery	Number/Cells	204	
	Capacity	450	Ah
Battery Voltage	EOD	1.67vpc	V
	Low Battery	1.82vpc	V
	Maximum	2.85vpc	V
Battery Boost	Enable	N	Y/N
	Automatic	N	Y/N
	Duration	0	M
	Threshold	0	V

SECTION 5 HARDWARE COMMISSIONING

5.1 RECTIFIER SETUP

Voltage Level	Manual	460	V
	Float	460	V
	Boost	460	V
	Test	460	V
Battery CB Operation		√	√ / X
Battery Current Limit		45	A

5.2 INVERTER SETUP

R – N	232	V
S – N	232	V
T – N	232	V
Bypass Sync	n/a	√ / X

5.3 AUXILIARY ITEMS CHECK

Transfer Inverter to Bypass	√	√ / X
Transfer Bypass to Inverter	√	√ / X
DC Bus Ripple	0.2	VAC
Filter I R/S/T 133 | 133 | 133		A
AC-DC PCB Check	√	√ / X
DC-DC PCB Check	√	√ / X
Fan Operation	√	√ / X
Battery Circuit Breaker Operation	√	√ / X

NOTE:

Page 2 Redundant 1+1 Parallel Option Startup
Page 3 Capacity 1+1 Parallel Option Startup
Page 4 Multi-Module 1+N Parallel Option Startup

T Mobile
Site Witness Testing
UPS 1

Following the start up of an Emerson Network Power module UPS system, the battery will be left on its commissioning charge for a period of five to seven days. On completion of the commissioning charge the following proving tests will be performed to demonstrate the correct operation of the system. The tests assume that the UPS is **NOT** connected to a critical load, and that full access to **ALL** associated switch gear is available. Load bank connection will be at the output of the UPS installation, including any associated maintenance bypass switchgear.

Test Equipment Required

Fluke 435power analyser or similar.
Graphtec WR9000 transient recorder or similar.
Fluke 87 digital voltmeter or similar.
Heme 1000 current clamp or similar.

1. System Operation and Function

To verify the correct function of the UPS module the following tests will be carried out:

a: UPS start up.
Close the rectifier input circuit breaker, observe the UPS walks in to nominal DC Bus level (as calculated for battery float charge) and the inverter starts, regulating to 415Vac.
b: Battery circuit breaker operation.
Close the battery circuit breaker. Verify that the mimic display status indicates closure of the circuit breaker, and the alarm status is correct.
c: Close the bypass circuit breaker. Verify that the mimic display status indicates closure of the circuit breaker, and that the alarm status is correct.
d: Close the output circuit breaker. Verify that the mimic display status indicates closure and the alarm status is correct.
e: Operate the 'Emergency Stop' push button on the UPS. Verify the UPS module shuts down with the 'Emergency Shutdown' alarm displayed and the battery circuit breaker has tripped.

2. Module load tests

With the UPS operating normally the following parameters will be recorded using calibrated instruments and form the UPS display:

a: Input a.c. voltage, current and frequency
b: Bypass a.c. input voltage and frequency
c: Output a.c. voltage , current, and frequency
d: Battery voltage and current.
f: Real and apparent power
g: Voltage and current THD

These parameters will be recorded for the following load conditions:

a: No Load
b: 50% Load
c: 100% Load

3. Battery Autonomy Tests

Whilst in normal operation; the UPS will be loaded to 100% load at unity power factor. Record the output voltage and current. The supply to the module will be failed. The time taken to discharge the battery to the low battery cut off will be recorded. During this time the following parameters will be recorded:

a: Battery voltage
b: Battery current

On completion of the autonomy test, the UPS will be restarted, and the battery recharged. The recharge current limit will be verified as correct according to the battery manufacturer's specification.

4. Transient Performance

With the UPS in normal operation, the following load step tests will be performed, using the application / removal of load as a trigger source.

a: Load step 0% to 50% at unity power factor
b: Load step 50% to 0% at unity power factor
c: Load step 50% to 100% at unity power factor
d: Load step 100% to 50% at unity power factor

5. Static Switch Operation

With the UPS in normal operation supplying 100% load at unity power factor:

a: Simulate failure of the inverter, verify that the UPS transfers the load to the bypass supply without a break.
b: Restart all inverter; verify that the UPS transfers the load from bypass to inverter supply.

6. Harmonic Analysis

With the UPS in its normal operational state, apply 100% load at unity power factor. An harmonic analysis of voltage and current will be carried out on the rectifier input supply.

T Mobile
Site Witness Testing
UPS 1

System Equipment Record

	Equipment Type	Serial Number
UPS Module	HiPulse-E 400kVA	90009302
	Type	No of cells/strings per module
Battery	3 x 34 x WING 12V150AH	204 / 3

Test Equipment

Equipment	**Manufacturer & Model**	**Serial No.**	**Cal. Date:**
Multimeter	Fluke 87	UPS0090	28/09/10
Current Clamp	Fluke 337	09280380	22/01/11
Harmonic Analyser	Fluke 435	DM9241057	08/09/11
Transient Recorder	Yokogawa DL750	91F341504	12/05/11
Harmonic Analyser	Fluke 435	11800026	25/03/13

T Mobile
Site Witness Testing
UPS 1

MODULE TESTS

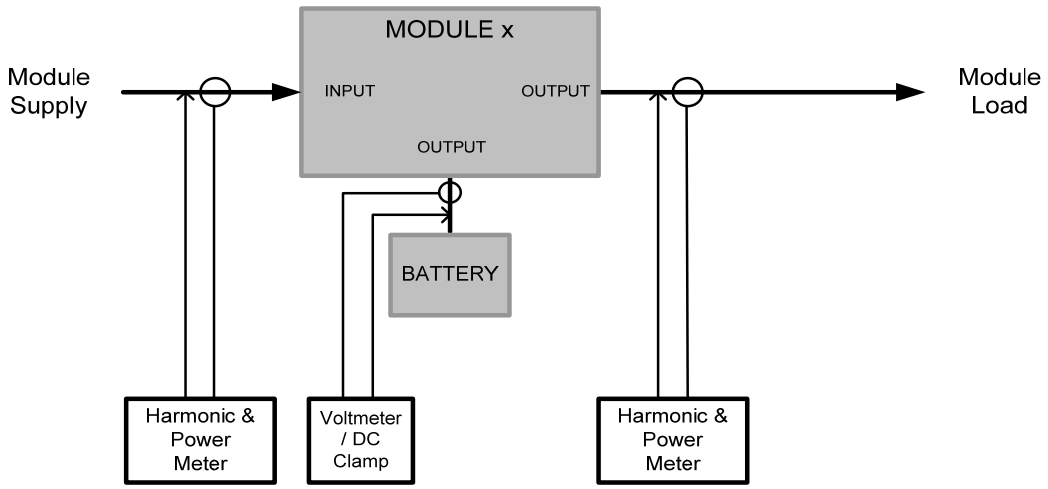
System Operation and Function Record

Test ref:	Action	Result	Units
1a	Close Input circuit breaker, UPS walk-in occurs. Record time taken.	37	Secs
	DC Bus level	459	VDC
	AC Voltage (Nominal)	400	VAC
b	Close Battery Circuit Breaker, mimic status correct	Y	Y/N
	Alarm indication correct	Y	Y/N
c	Close Bypass Circuit Breaker, mimic status correct	Y	Y/N
	Alarm indication correct	Y	Y/N
d	Close Output Circuit Breaker, mimic status correct	Y	Y/N
	Alarm indication correct	Y	Y/N
e	Emergency stop operated. UPS shuts down	Y	Y/N
	Emergency shutdown alarm activated	Y	Y/N
	Battery Circuit Breaker tripped	Y	Y/N

T Mobile
Site Witness Testing
UPS 1

Steady State Loading

Test Equipment configuration.



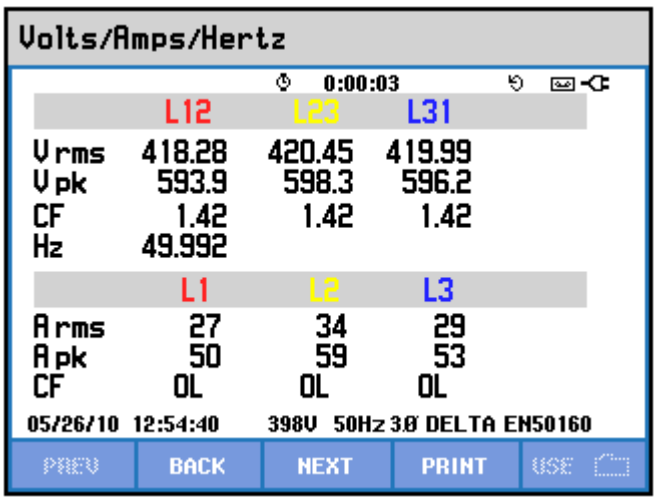
T Mobile
Site Witness Testing
UPS 1

Module Load Test Record

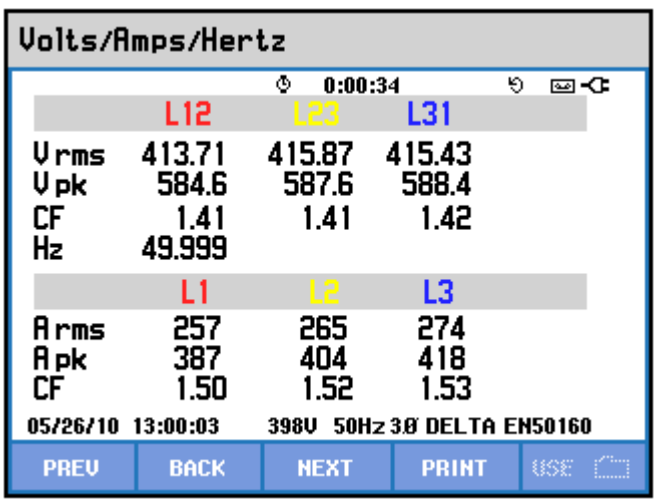
	0%	50%	100%	UNITS
Input volts RS	418	413	409	VAC
Input volts ST	420	415	411	VAC
Input volts TR	419	414	410	VAC
Input current R	27	257	529	Amps AC
Input current S	33	266	549	Amps AC
Input current T	29	274	553	Amps AC
Input frequency	49.95	49.99	49.99	Hz
Battery voltage	459	457	457	VDC
Battery current	0	0	0	Amps DC
Output voltage RS	403	400	398	VAC
Output voltage ST	403	400	398	VAC
Output voltage TR	403	400	398	VAC
Output current R	13	224	453	Amps AC
Output current S	15	221	444	Amps AC
Output current T	13	220	446	Amps AC
Output frequency	49.99	50.0	49.98	Hz
Real power input	13	166	332	KW
Apparent power input	20	190	385	KVA
Real power output	5.7	154	310	KW
Apparent power output	9.8	154	310	KVA
Input current THD	42	5.5	3.2	%
Input voltage THD	1.4	1	1.1	%
Output current THD	3.3	0.5	0.5	%
Output voltage THD	0.5	0.5	0.5	%
Efficiency		92.8	93.4	%

T Mobile
Site Witness Testing
UPS 1

In @ 0%

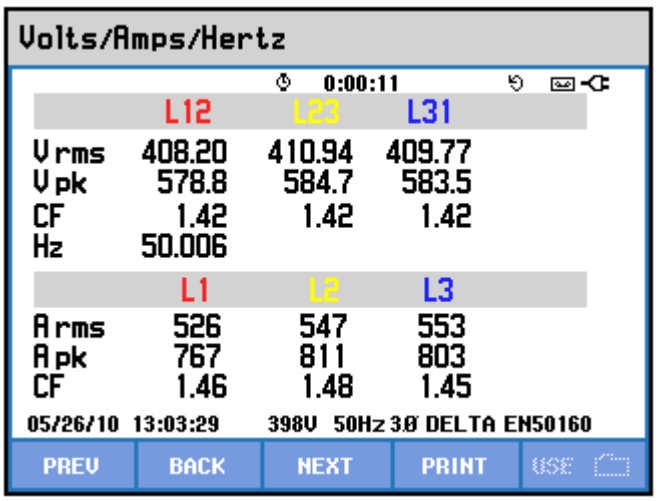


In @ 50%

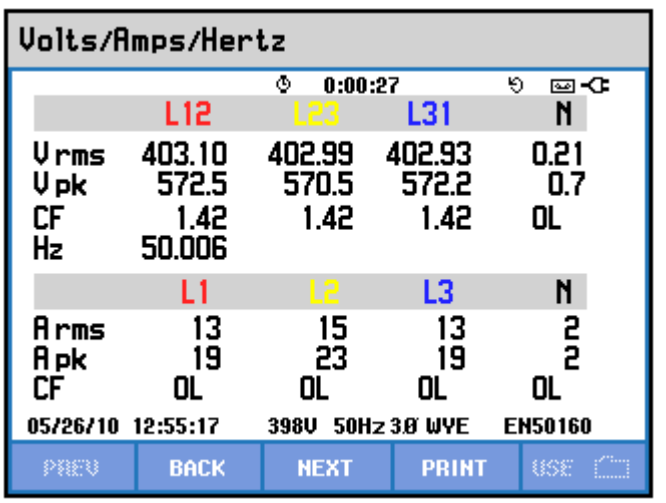


T Mobile
Site Witness Testing
UPS 1

In @ 100%

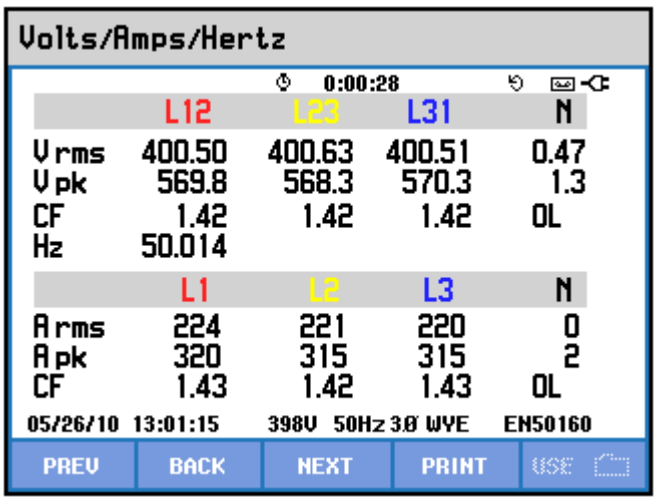


Out @ 0%

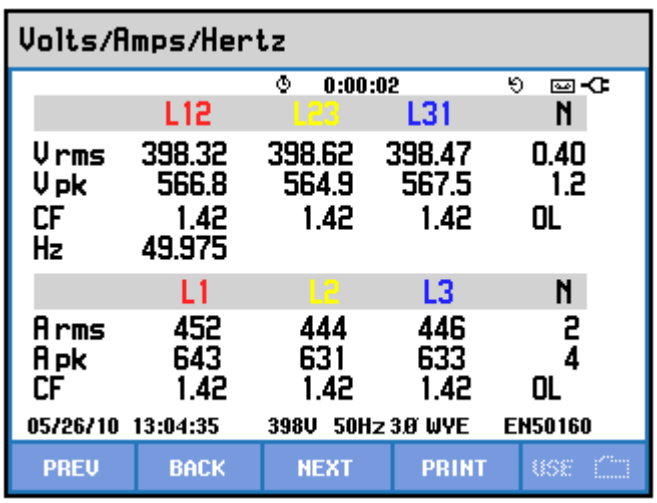


T Mobile
Site Witness Testing
UPS 1

Out @ 50%



Out @ 100%



T Mobile
Site Witness Testing
UPS 1

Battery Autonomy Test Record

100% load (@ unity pf) will be applied to the UPS and then the Module input supply will be failed (note: the bypass will be kept available to support the load bank in the case of a battery failure).

During the batteries discharge thermo scanning will be performed on all batteries connections including inside UPS and DC fuses and circuit breakers.

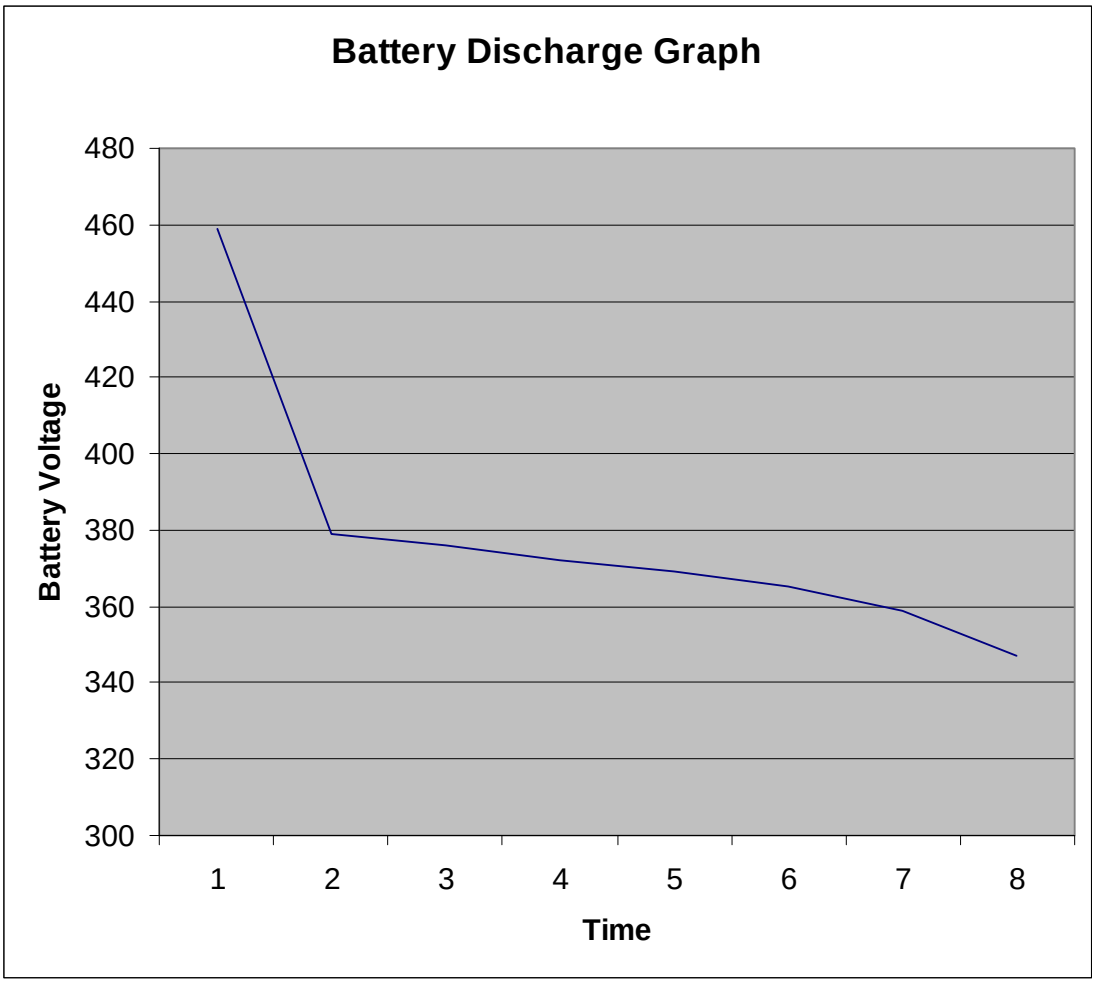
Start Load	320KW	
Time	DC volts	DC current
0	457	0
1	379	872
2	376	884
3	372	892
4	369	901
5	365	910
6	359	925
7	347	956
8	340	
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		

BATTERIES END DISCHARGE TIME: 7min 20 sec

Notes:
1. this test was performed with 320KW resistive load
2. recharge current measured at 42A

TESTS OK: YES

T Mobile
Site Witness Testing
UPS 1



T Mobile
Site Witness Testing
UPS 1

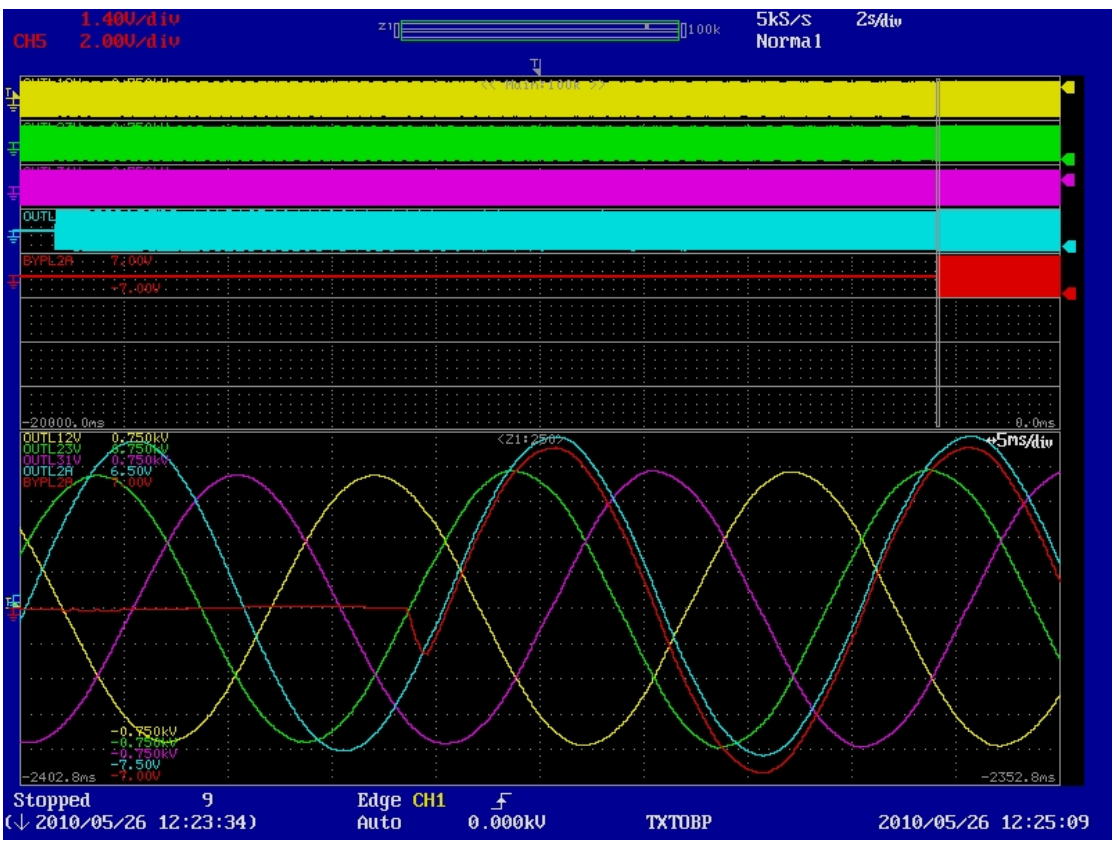
Transfer to/from Bypass Performance(Record Below)

With 100% load applied to the module (@ unity pf) the load will be transferred:

From UPS to Bypass (via UPS front panel controls)
From Bypass to UPS (via UPS front panel controls)

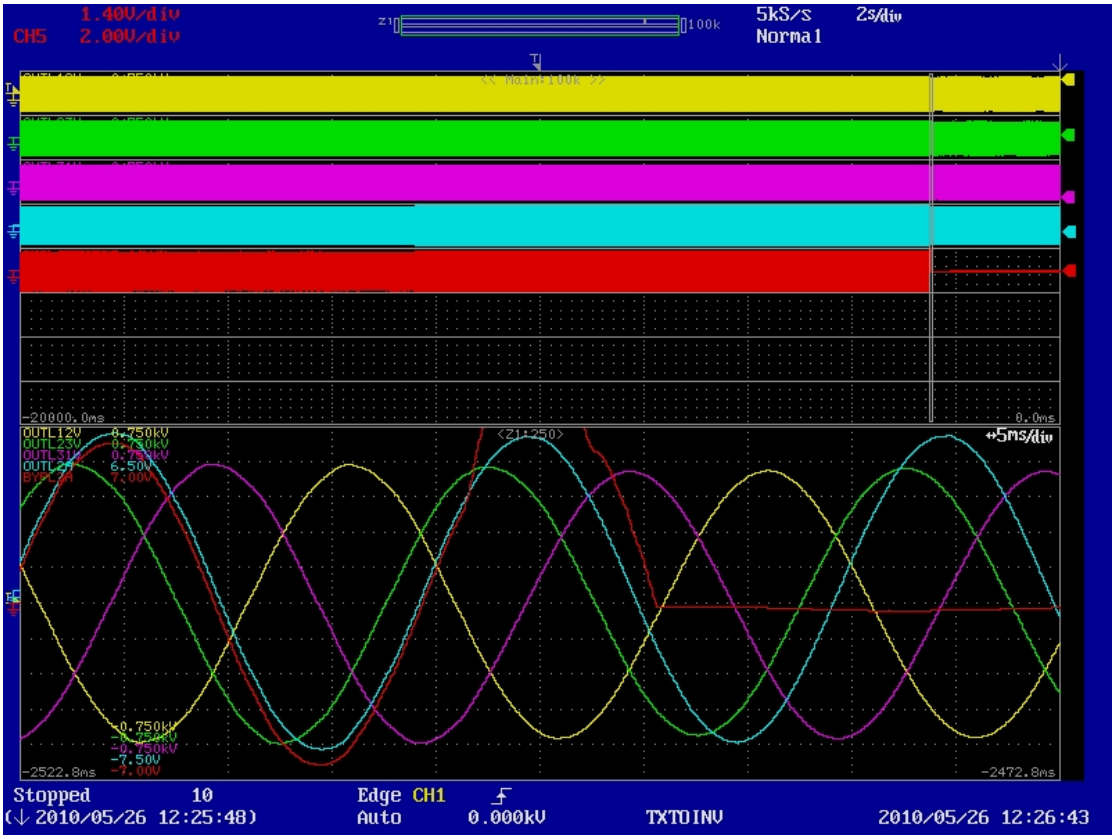
Channel 1, 2 and 3 records the Output Voltage, Channel 4 records the Output Current on one of the phases, while Channel 5 records Bypass Current on one of the phases.

Display transfer to Bypass



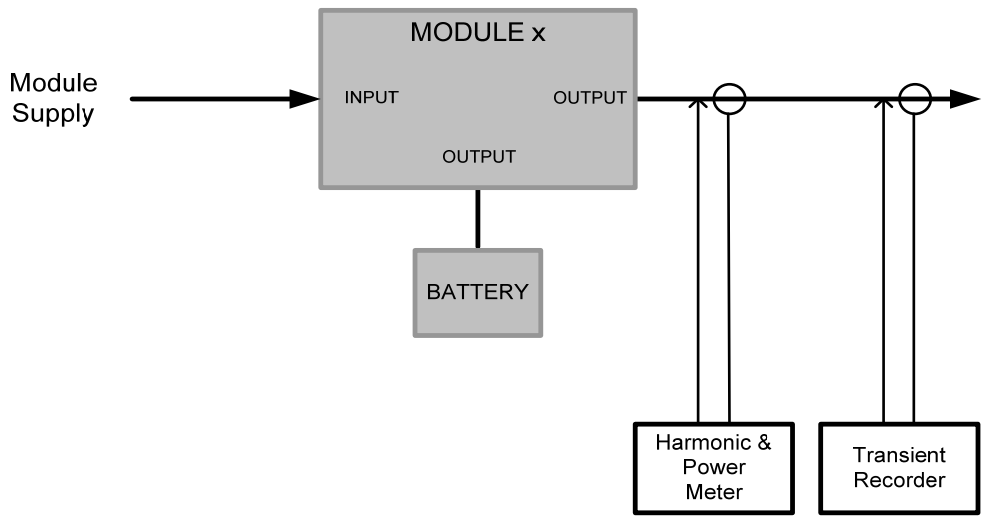
T Mobile
Site Witness Testing
UPS 1

Display transfer from Bypass



Transient Performance(Record Below)

Test Equipment configuration.



The following load levels (@ unity pf) will be applied to the UPS:

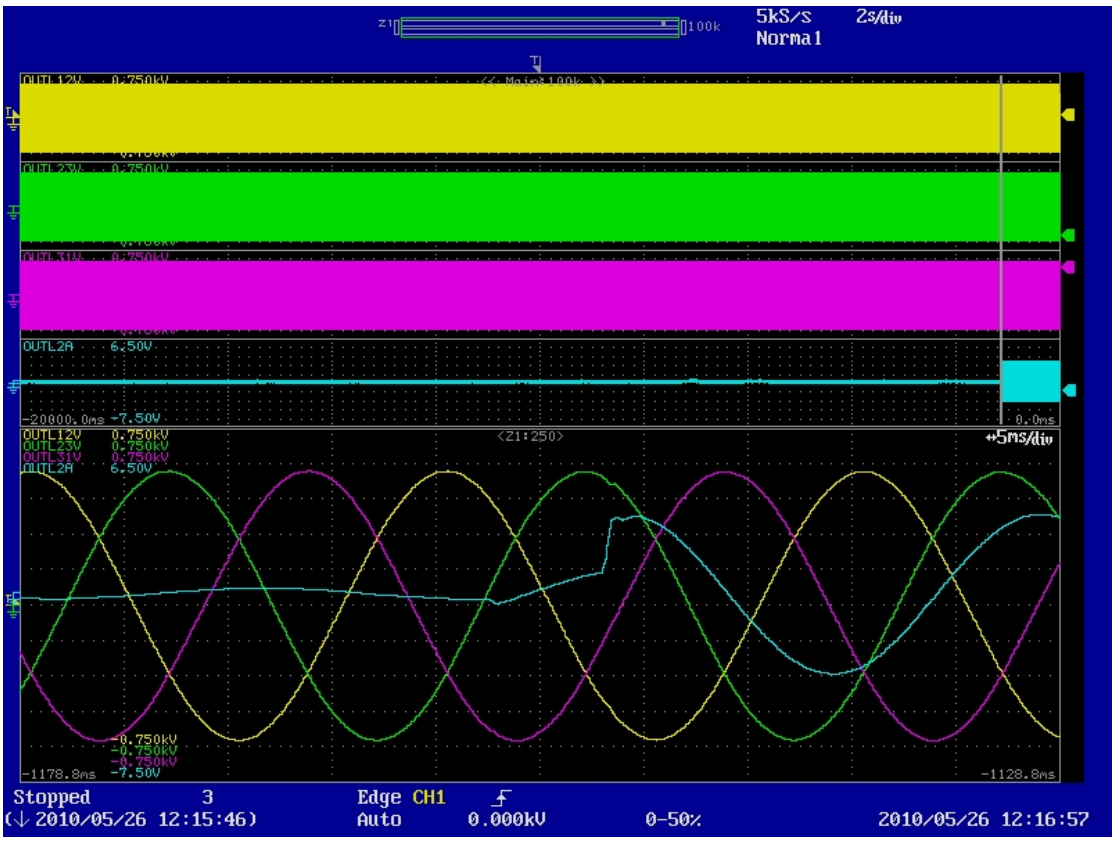
0% - 50%
50% -100%
100% - 50%
50% - 0%
0% - 100%
100% - 0%
Mains Fail @100%

During each load level change the following parameter will be recorded using the Transient recorder.

Channel 1, 2 and 3 records the Output Voltage and Channel 4 records the Output Current on one of the phases and is used for triggering the recording.

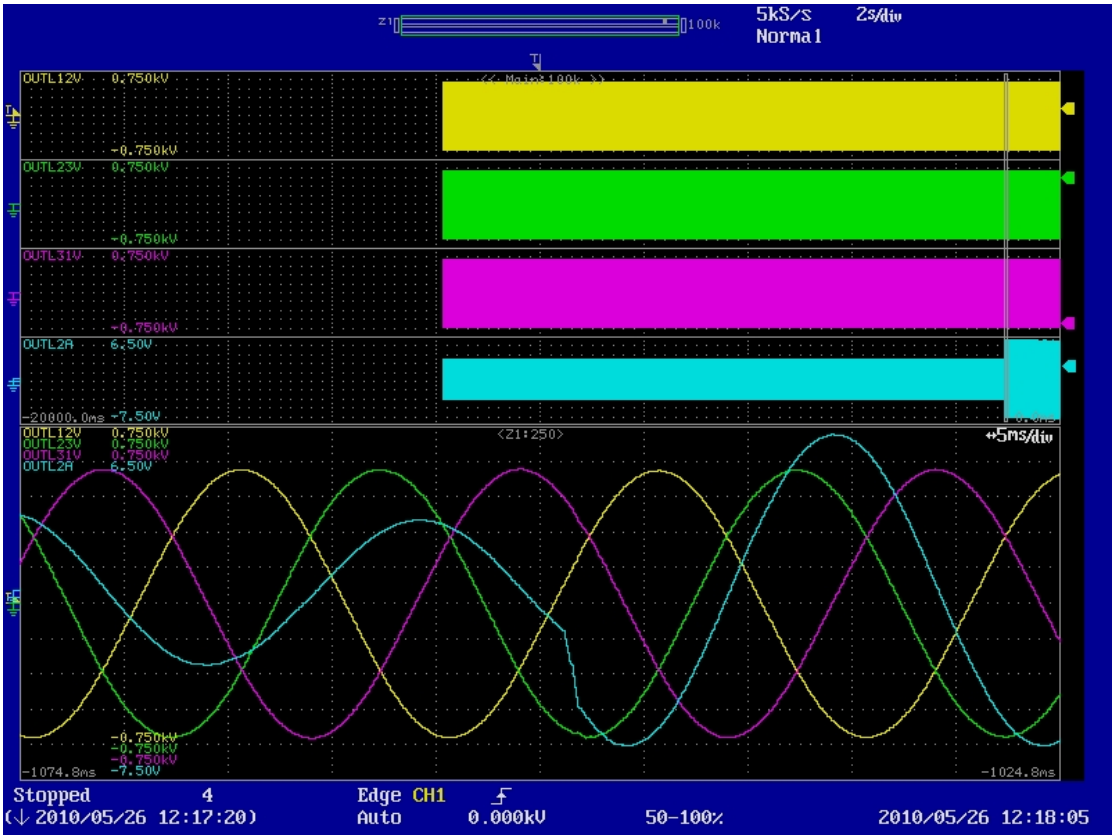
T Mobile
Site Witness Testing
UPS 1

0-50% Step Load



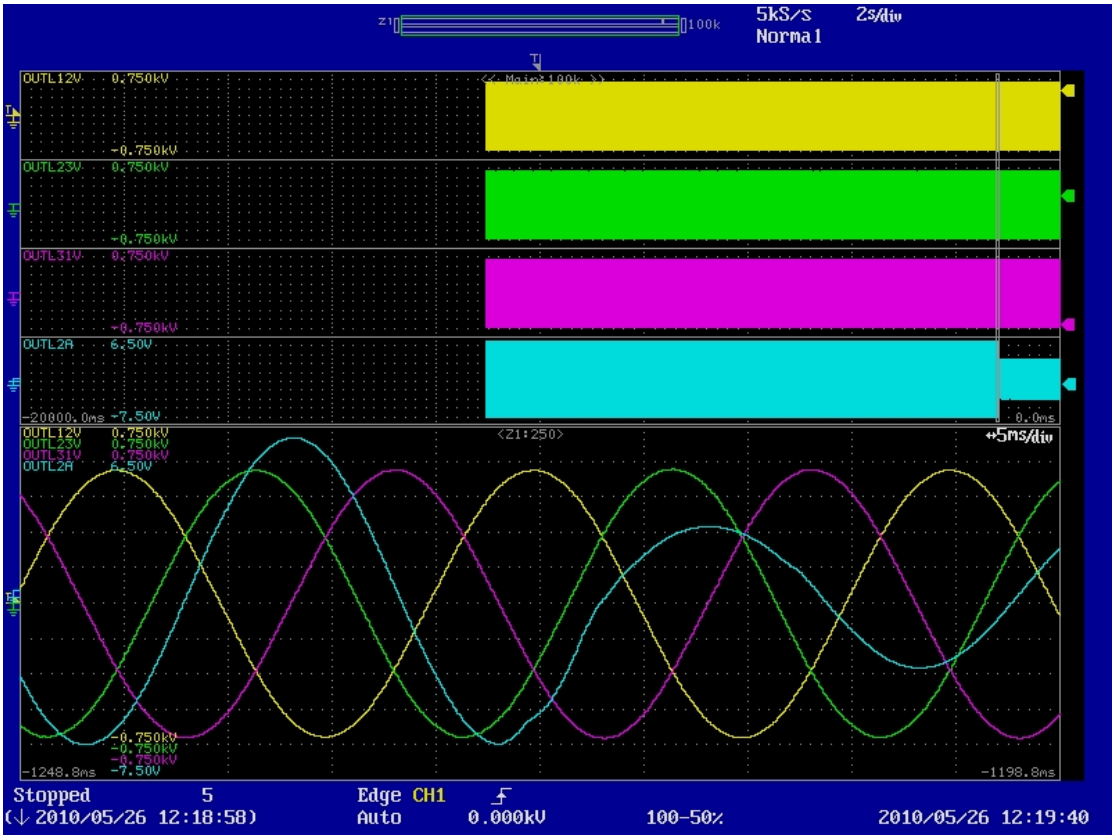
T Mobile
Site Witness Testing
UPS 1

50% to 100% Step Load

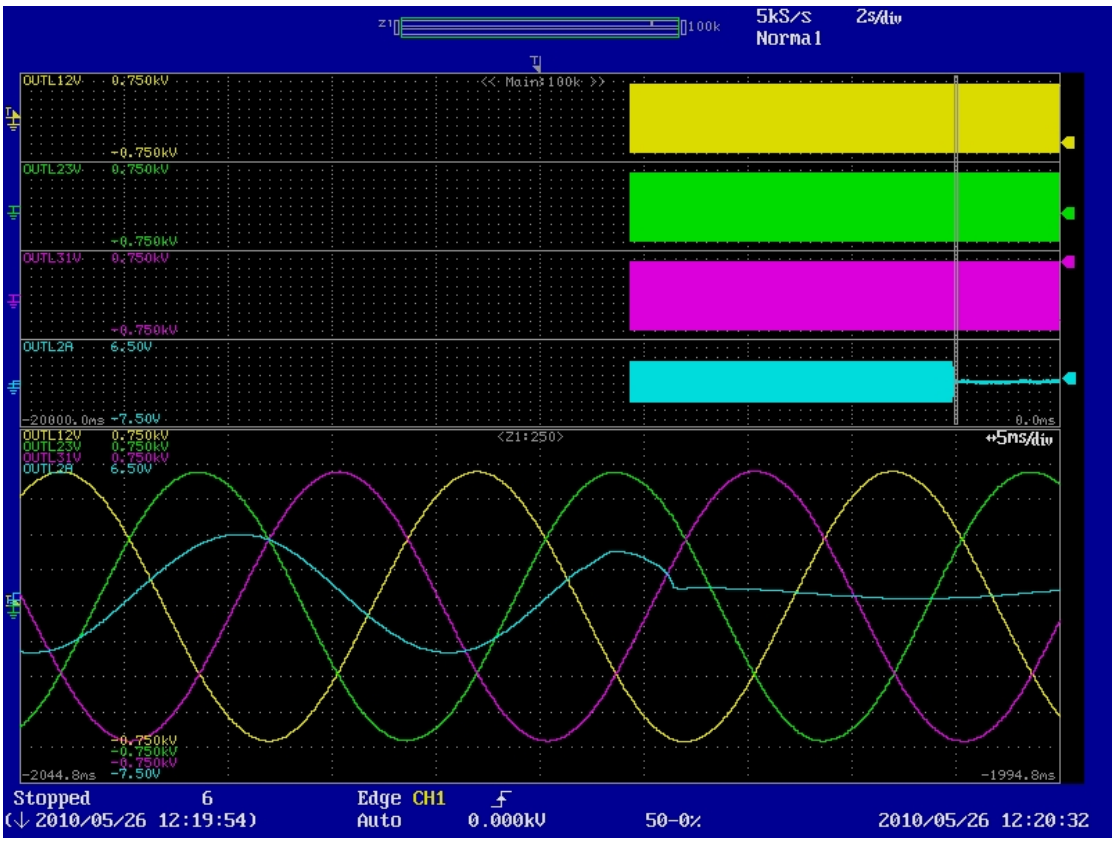


T Mobile
Site Witness Testing
UPS 1

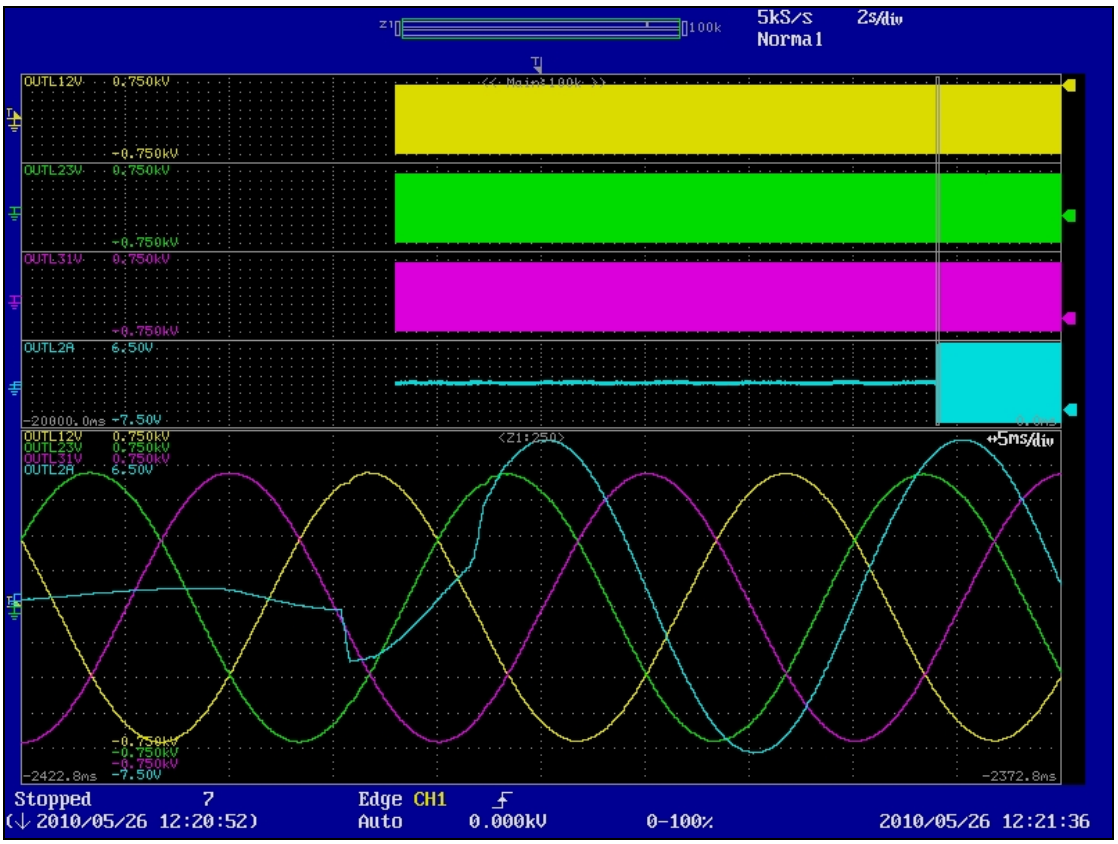
100% to 50% Step Load



T Mobile
Site Witness Testing
UPS 1

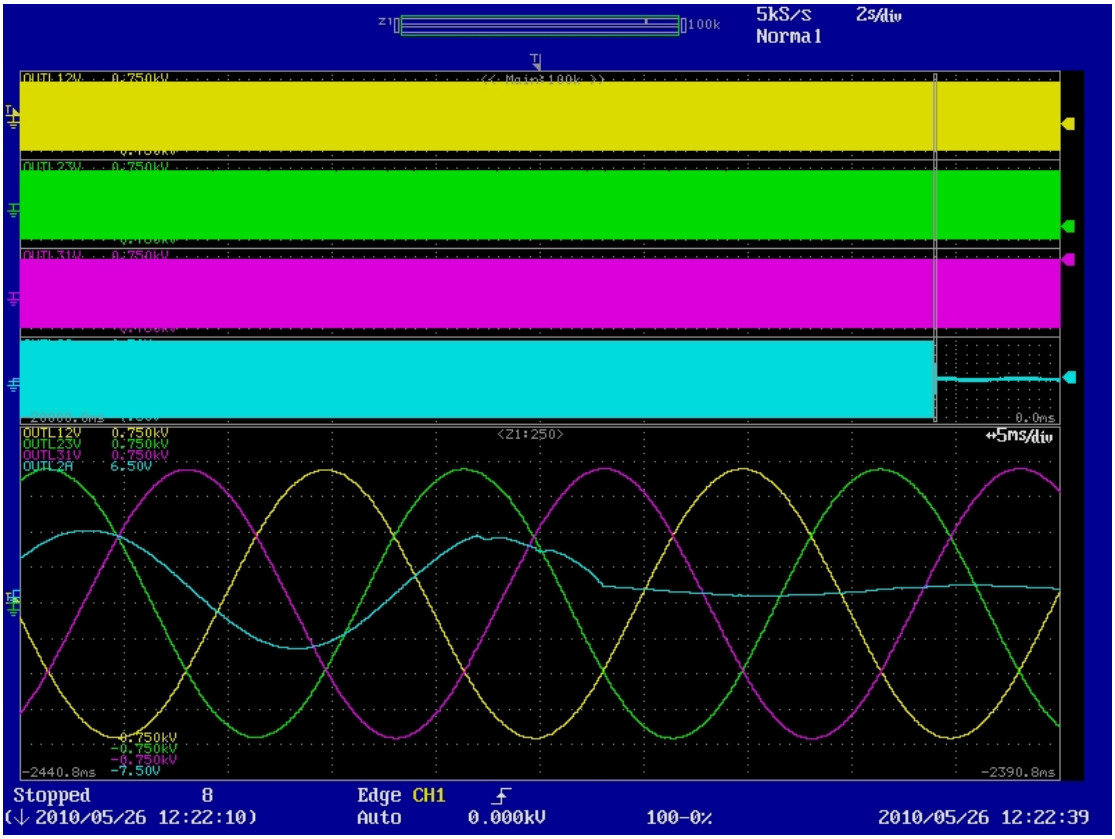


T Mobile
Site Witness Testing
UPS 1



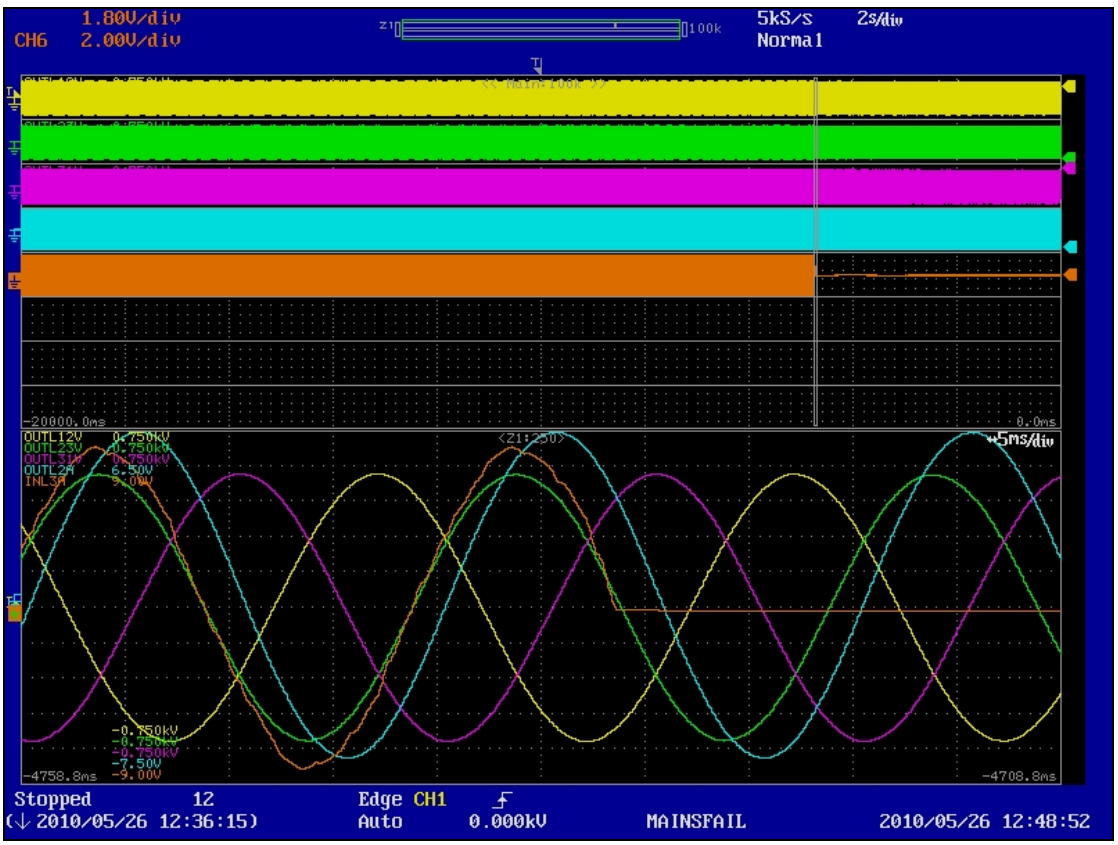
T Mobile
Site Witness Testing
UPS 1

100%-0 Step Load



T Mobile
Site Witness Testing
UPS 1

Mains Fail @ 100%



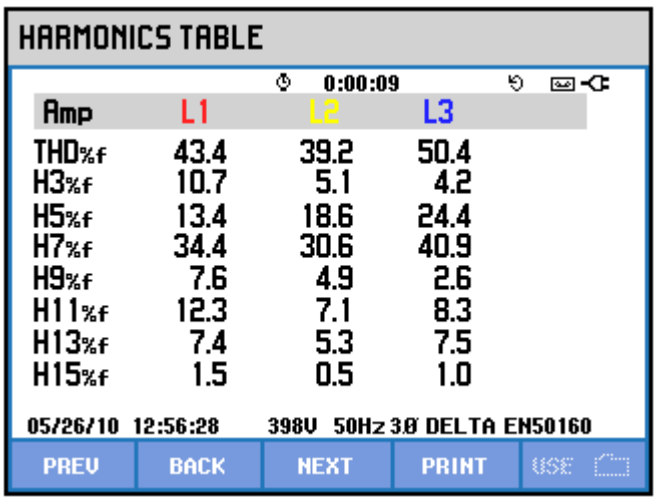
TESTS OK: YES

T Mobile
Site Witness Testing
UPS 1

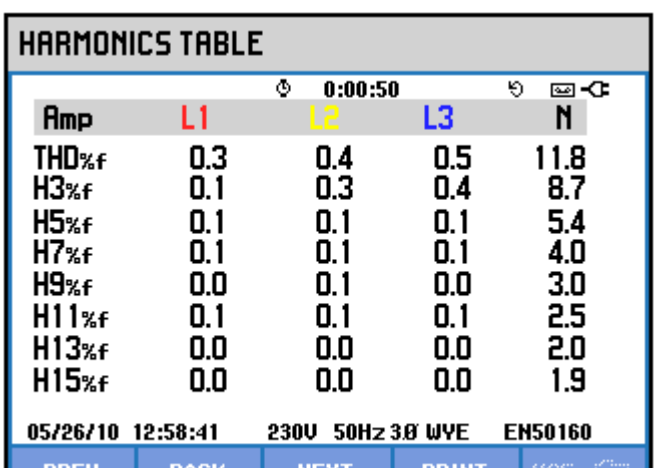
Harmonic Analysis (Record Below)

With 0%, 50% and 100% load applied to the module (@ unity pf), input current and output voltage THD will be recorded using Fluke 435 platform.

0% Load
Input Current



Output Voltage



T Mobile
Site Witness Testing
UPS 1

50% Load
Current

HARMONICS TABLE

0:02:43

Amp	L1	L2	L3
THD%f	5.6	5.6	5.5
H3%f	2.3	1.3	1.8
H5%f	1.4	1.4	1.1
H7%f	3.2	3.3	3.3
H9%f	0.3	1.5	1.3
H11%f	0.3	0.2	0.2
H13%f	3.3	3.2	3.2
H15%f	0.1	0.1	0.1

05/26/10 12:59:02 398V 50Hz 3Ø DELTA EN50160

PREV BACK NEXT PRINT USB

Voltage

HARMONICS TABLE

0:00:02

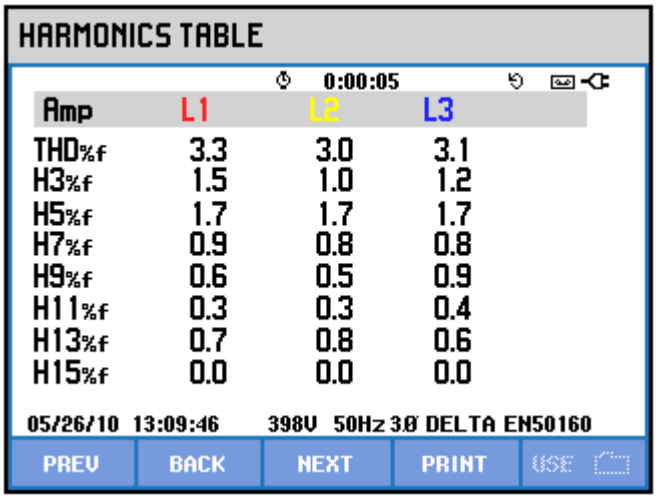
Volt	L1	L2	L3	N
THD%f	0.4	0.5	0.5	80.6
H3%f	0.2	0.4	0.4	55.7
H5%f	0.1	0.1	0.1	5.6
H7%f	0.1	0.1	0.1	19.0
H9%f	0.1	0.0	0.1	25.9
H11%f	0.1	0.1	0.0	4.7
H13%f	0.0	0.0	0.0	17.9
H15%f	0.0	0.0	0.0	24.9

05/26/10 12:59:05 230V 50Hz 3Ø WYE EN50160

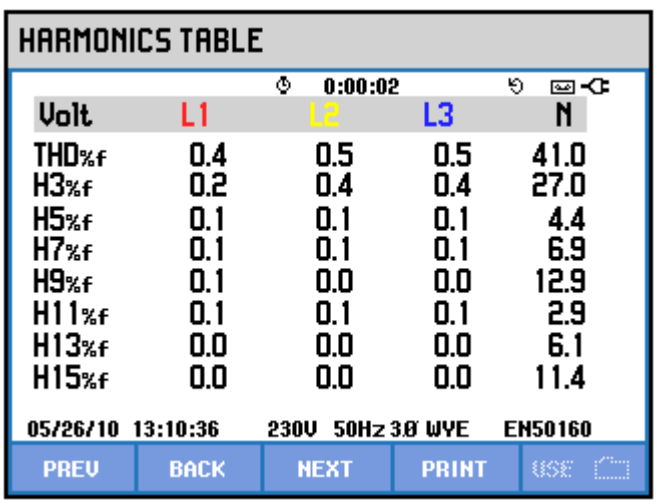
PREV BACK NEXT PRINT USB

T Mobile
Site Witness Testing
UPS 1

100% Load
Current



Voltage



TESTS OK: YES

T Mobile
Site Witness Testing
UPS 1

Transfer to and from Maintenance Bypass

With 100% load applied to the module (@ unity pf), load will be transferred to and from Maintenance Bypass. Recording equipment will be used to prove that there is no break in supply.

TESTS OK: YES

T Mobile
Site Witness Testing
UPS 2

Following the start up of an Emerson Network Power module UPS system, the battery will be left on its commissioning charge for a period of five to seven days. On completion of the commissioning charge the following proving tests will be performed to demonstrate the correct operation of the system. The tests assume that the UPS is **NOT** connected to a critical load, and that full access to **ALL** associated switch gear is available. Load bank connection will be at the output of the UPS installation, including any associated maintenance bypass switchgear.

Test Equipment Required

Fluke 435power analyser or similar.
Graphtec WR9000 transient recorder or similar.
Fluke 87 digital voltmeter or similar.
Heme 1000 current clamp or similar.

1. System Operation and Function

To verify the correct function of the UPS module the following tests will be carried out:

a: UPS start up.
Close the rectifier input circuit breaker, observe the UPS walks in to nominal DC Bus level (as calculated for battery float charge) and the inverter starts, regulating to 415Vac.

b: Battery circuit breaker operation.
Close the battery circuit breaker. Verify that the mimic display status indicates closure of the circuit breaker, and the alarm status is correct.

c: Close the bypass circuit breaker. Verify that the mimic display status indicates closure of the circuit breaker, and that the alarm status is correct.

d: Close the output circuit breaker. Verify that the mimic display status indicates closure and the alarm status is correct.

e: Operate the ‘Emergency Stop’ push button on the UPS. Verify the UPS module shuts down with the ‘Emergency Shutdown’ alarm displayed and the battery circuit breaker has tripped.

2. Module load tests

With the UPS operating normally the following parameters will be recorded using calibrated instruments and form the UPS display:

a: Input a.c. voltage, current and frequency
b: Bypass a.c. input voltage and frequency
c: Output a.c. voltage , current, and frequency
d: Battery voltage and current.
f: Real and apparent power
g: Voltage and current THD

These parameters will be recorded for the following load conditions:

a: No Load
b: 50% Load
c: 100% Load

3. Battery Autonomy Tests

Whilst in normal operation; the UPS will be loaded to 100% load at unity power factor. Record the output voltage and current. The supply to the module will be failed. The time taken to discharge the battery to the low battery cut off will be recorded. During this time the following parameters will be recorded:

a: Battery voltage
b: Battery current

On completion of the autonomy test, the UPS will be restarted, and the battery recharged. The recharge current limit will be verified as correct according to the battery manufacturer's specification.

4. Transient Performance

With the UPS in normal operation, the following load step tests will be performed, using the application / removal of load as a trigger source.

a: Load step 0% to 50% at unity power factor
b: Load step 50% to 0% at unity power factor
c: Load step 50% to 100% at unity power factor
d: Load step 100% to 50% at unity power factor

5. Static Switch Operation

With the UPS in normal operation supplying 100% load at unity power factor:

a: Simulate failure of the inverter, verify that the UPS transfers the load to the bypass supply without a break.
b: Restart all inverter; verify that the UPS transfers the load from bypass to inverter supply.

6. Harmonic Analysis

With the UPS in its normal operational state, apply 100% load at unity power factor. An harmonic analysis of voltage and current will be carried out on the rectifier input supply.

T Mobile
Site Witness Testing
UPS 2

System Equipment Record

	Equipment Type	Serial Number
UPS Module	HiPulse-E 400kVA	90009301
	Type	No of cells/strings per module
Battery	3 x 34 x WING 12V150AH	204 / 3

Test Equipment

Equipment	**Manufacturer & Model**	**Serial No.**	**Cal. Date:**
Multimeter	Fluke 87	UPS0090	28/09/10
Current Clamp	Fluke 337	09280380	22/01/11
Harmonic Analyser	Fluke 435	DM9241057	08/09/11
Transient Recorder	Yokogawa DL750	91F341504	12/05/11
Harmonic Analyser	Fluke 435	11800026	25/03/13

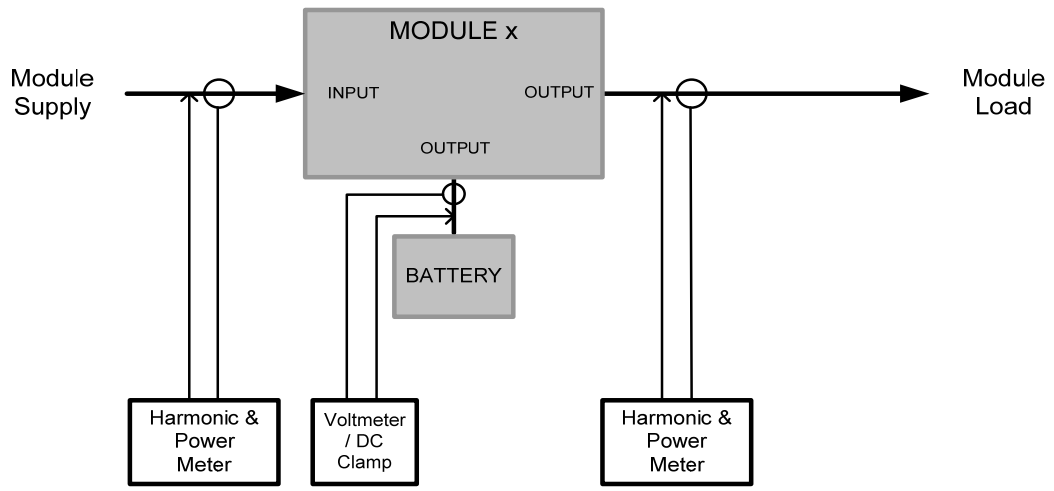
MODULE TESTS

System Operation and Function Record

Test ref:	Action	Result	Units
1a	Close Input circuit breaker, UPS walk-in occurs. Record time taken.	40	Secs
	DC Bus level	459	VDC
	AC Voltage (Nominal)	400	VAC
b	Close Battery Circuit Breaker, mimic status correct	Y	Y/N
	Alarm indication correct	Y	Y/N
c	Close Bypass Circuit Breaker, mimic status correct	Y	Y/N
	Alarm indication correct	Y	Y/N
d	Close Output Circuit Breaker, mimic status correct	Y	Y/N
	Alarm indication correct	Y	Y/N
e	Emergency stop operated. UPS shuts down	Y	Y/N
	Emergency shutdown alarm activated	Y	Y/N
	Battery Circuit Breaker tripped	Y	Y/N

Steady State Loading

Test Equipment configuration.



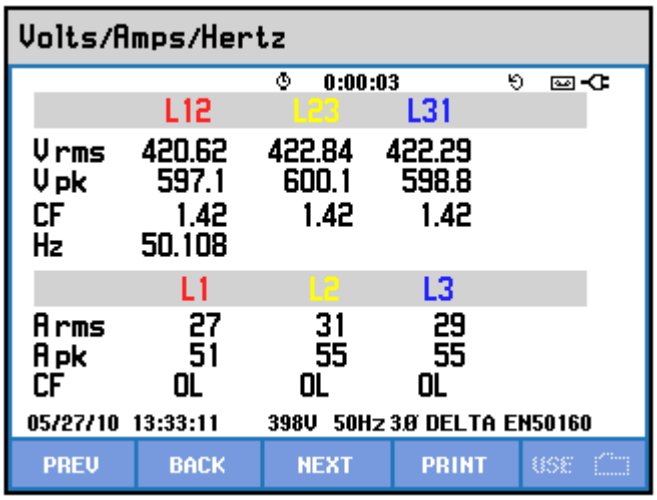
T Mobile
Site Witness Testing
UPS 2

Module Load Test Record

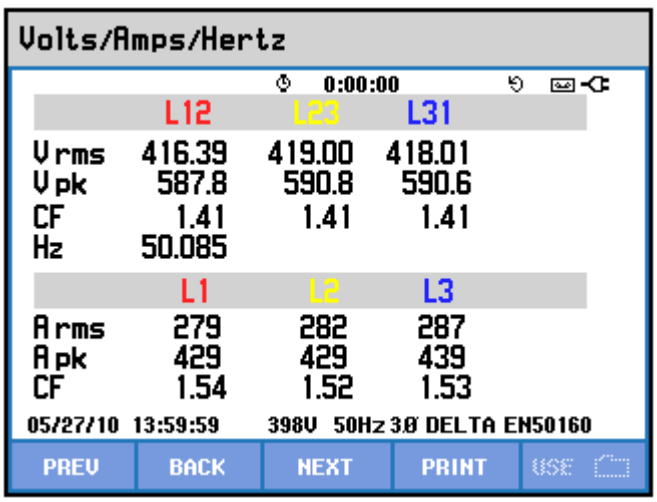
	0%	50%	100%	UNITS
Input volts RS	420	416	411	VAC
Input volts ST	423	419	414	VAC
Input volts TR	422	418	412	VAC
Input current R	27	279	533	Amps AC
Input current S	31	284	545	Amps AC
Input current T	29	288	542	Amps AC
Input frequency	50.11	50.07	49.99	Hz
Battery voltage	459	457	456	VDC
Battery current	0	0	0	Amps DC
Output voltage RS	403	401	399	VAC
Output voltage ST	403	401	399	VAC
Output voltage TR	403	401	399	VAC
Output current R	13	237	446	Amps AC
Output current S	15	239	449	Amps AC
Output current T	13	239	451	Amps AC
Output frequency	50.13	50.07	49.99	Hz
Real power input	12.8	177	331	KW
Apparent power input	19.5	204	386	KVA
Real power output	6.1	166	311	KW
Apparent power output	9.6	166	311	KVA
Input current THD	43	5.2	3.1	%
Input voltage THD	1.2	1	0.9	%
Output current THD	3.2	0.5	0.5	%
Output voltage THD	0.5	0.5	0.5	%
Efficiency		93.7	93.9	%

T Mobile
Site Witness Testing
UPS 2

In @ 0%

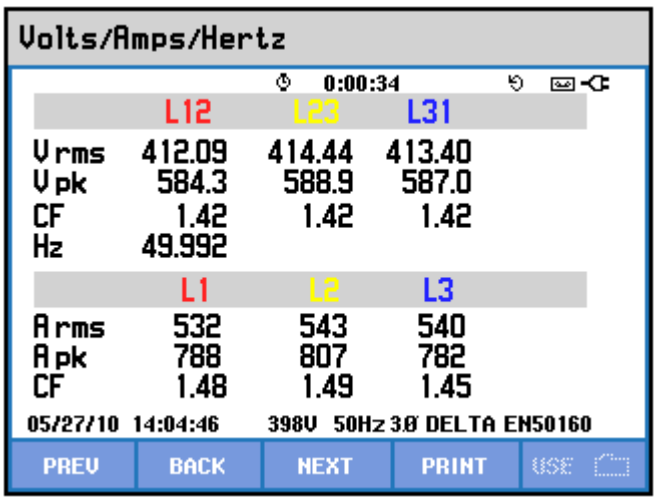


In @ 50%

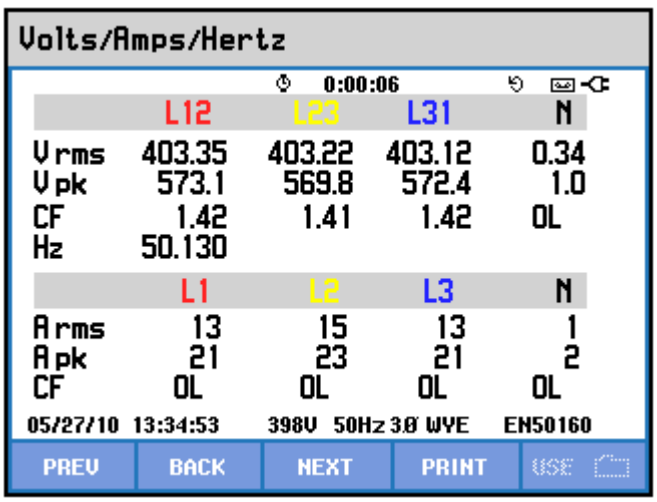


T Mobile
Site Witness Testing
UPS 2

In @ 100%

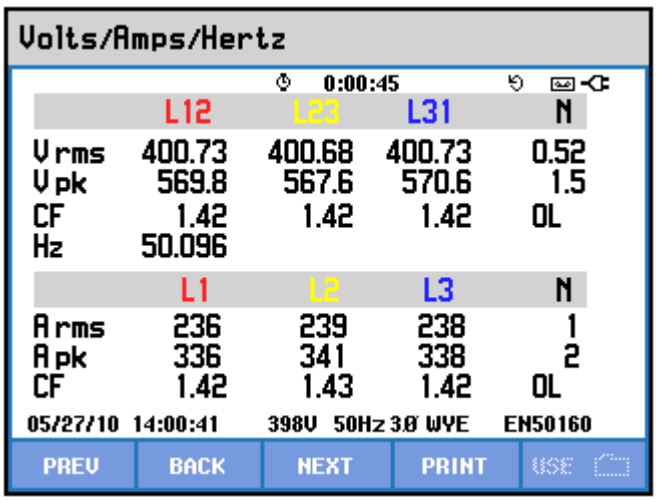


Out @ 0%

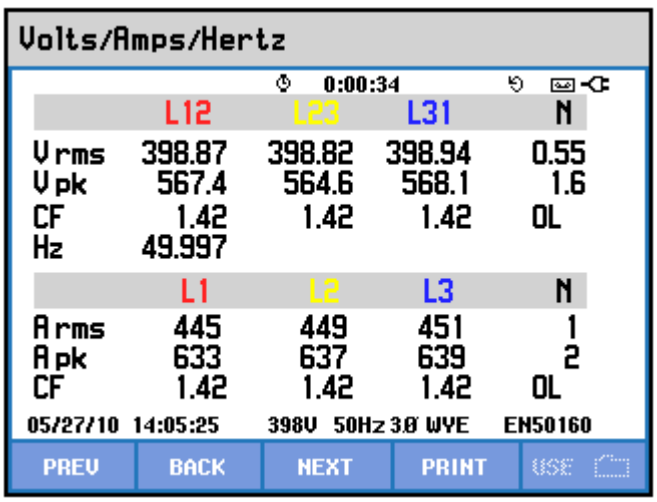


T Mobile
Site Witness Testing
UPS 2

Out @ 50%



Out @ 100%



T Mobile
Site Witness Testing
UPS 2

Battery Autonomy Test Record

100% load (@ unity pf) will be applied to the UPS and then the Module input supply will be failed (note: the bypass will be kept available to support the load bank in the case of a battery failure).

During the batteries discharge thermo scanning will be performed on all batteries connections including inside UPS and DC fuses and circuit breakers.

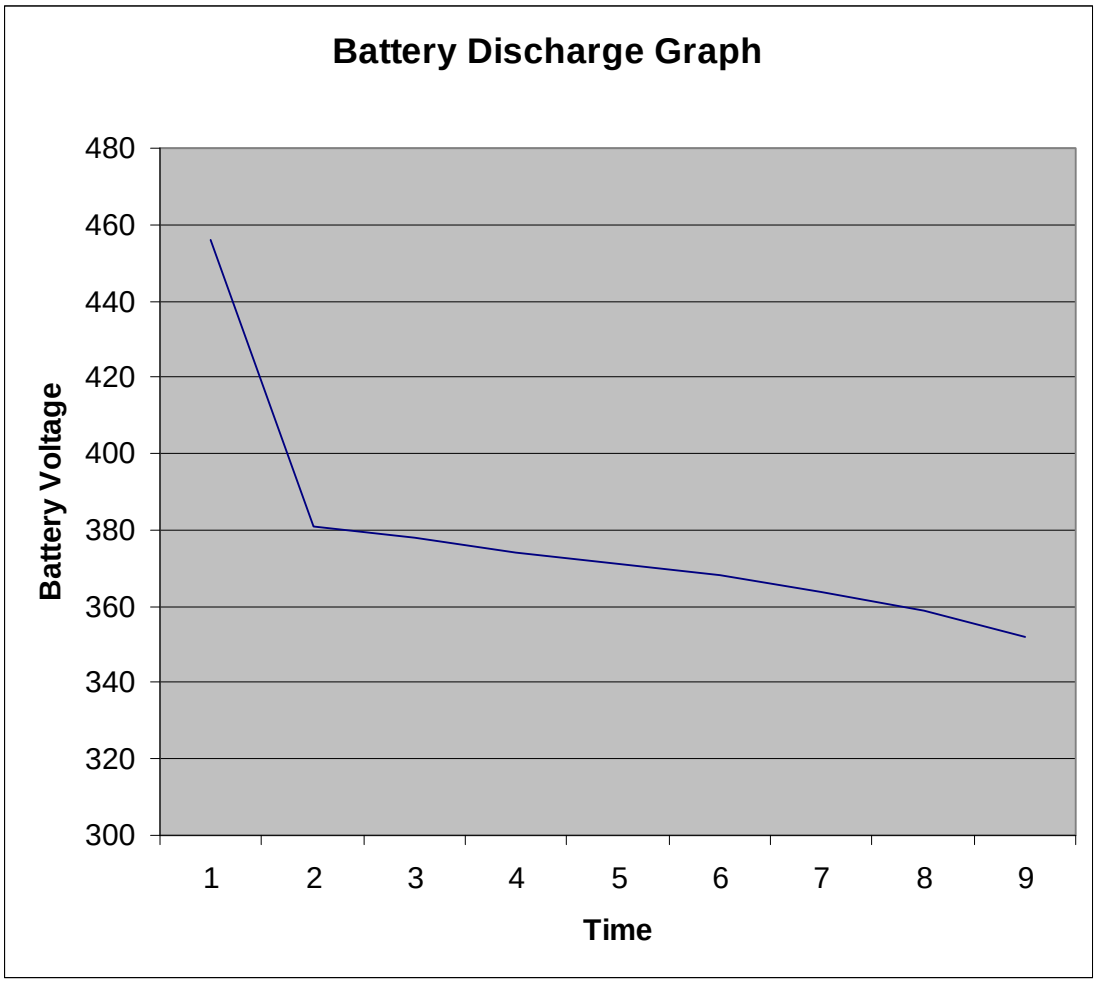
Start Load	320KW	
Time	DC volts	DC current
0	456	0
1	381	880
2	378	887
3	374	897
4	371	902
5	368	909
6	364	918
7	359	928
8	352	947
9	340	
10		
11		
12		
13		
14		
15		
16		
17		
18		

BATTERIES END DISCHARGE TIME: 7min 20 sec

Notes: 1. Recharge current measured at 42A

TESTS OK: YES

T Mobile
Site Witness Testing
UPS 2



T Mobile
Site Witness Testing
UPS 2

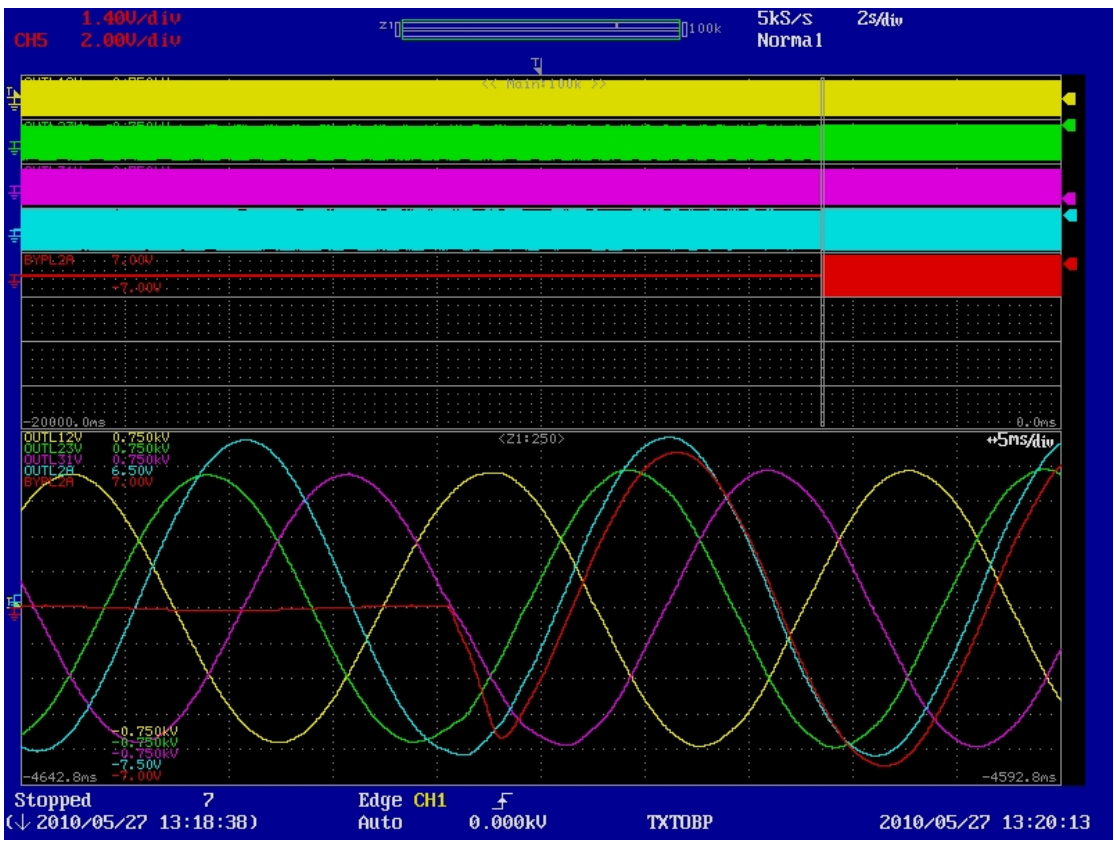
Transfer to/from Bypass Performance(Record Below)

With 100% load applied to the module (@ unity pf) the load will be transferred:

From UPS to Bypass (via UPS front panel controls)
From Bypass to UPS (via UPS front panel controls)

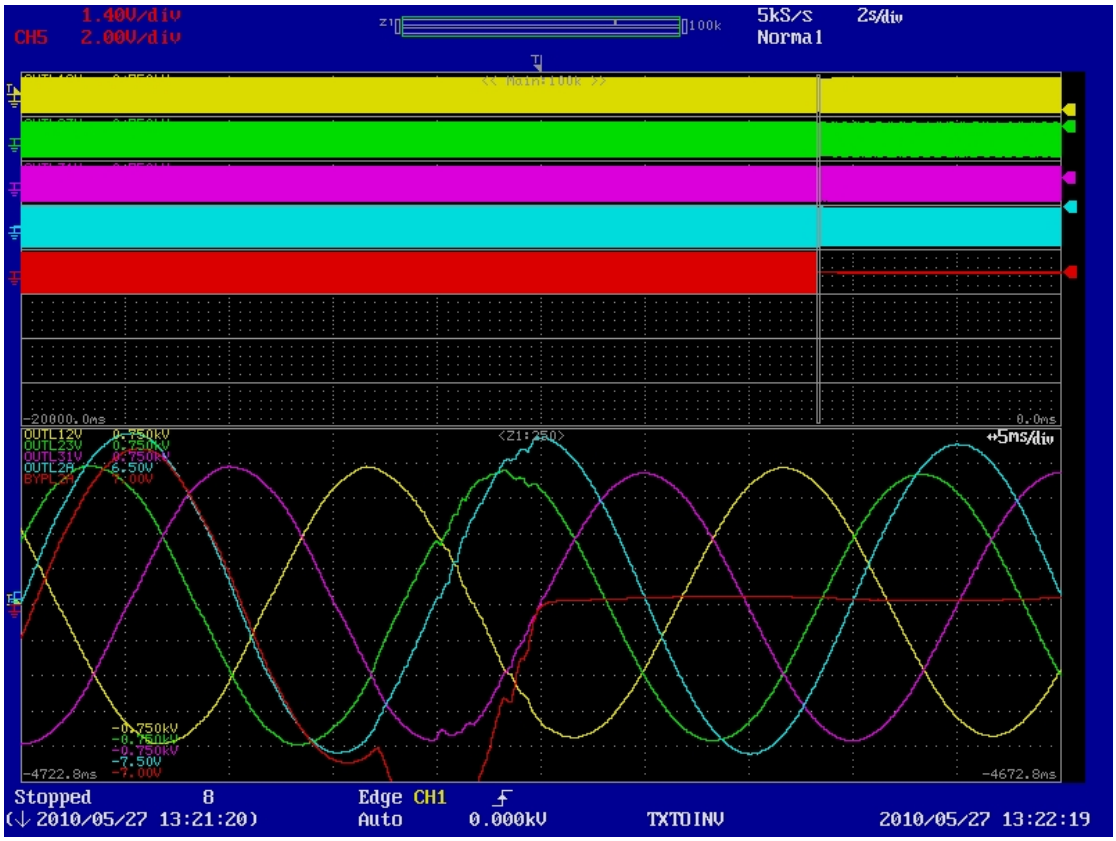
Channel 1, 2 and 3 records the Output Voltage, Channel 4 records the Output Current on one of the phases, while Channel 5 records Bypass Current on one of the phases.

Display transfer to Bypass



T Mobile
Site Witness Testing
UPS 2

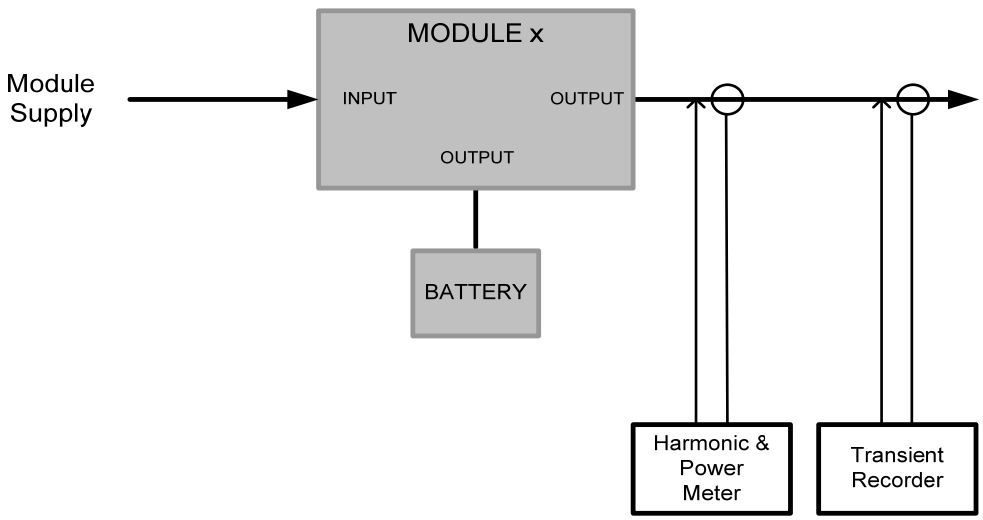
Display transfer from Bypass



TESTS OK: YES

Transient Performance(Record Below)

Test Equipment configuration.



The following load levels (@ unity pf) will be applied to the UPS:

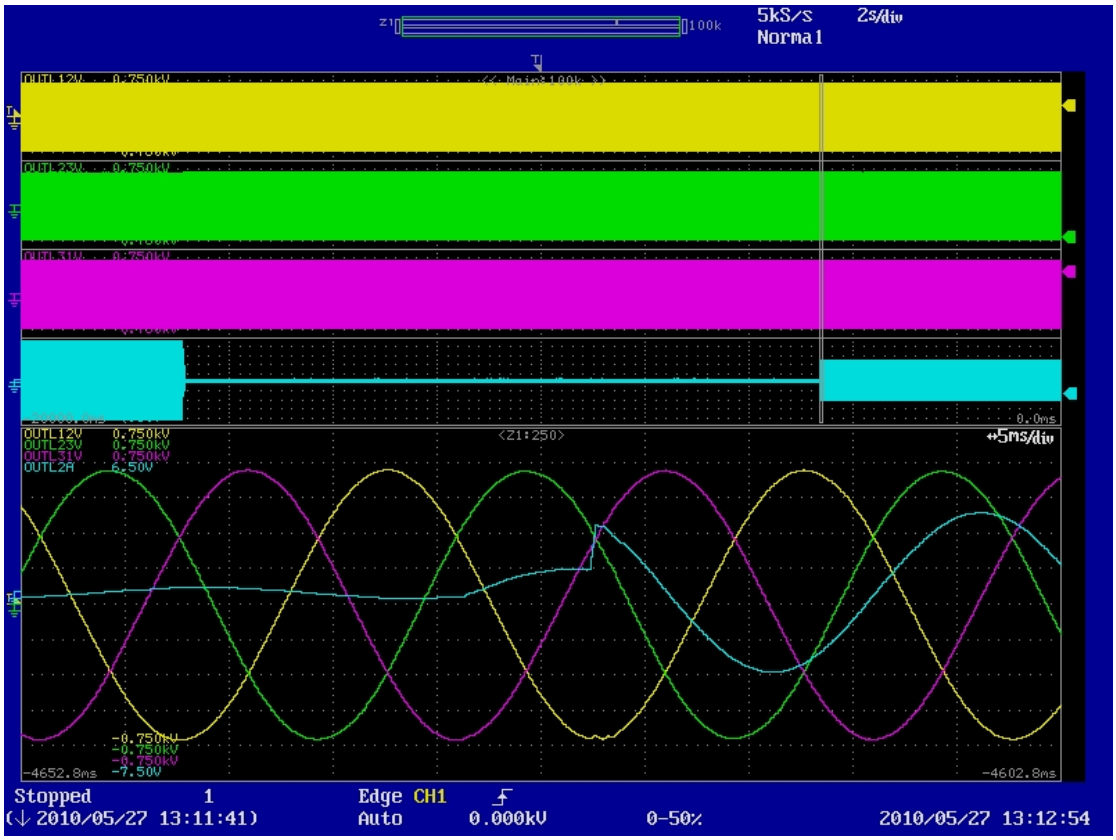
0% - 50%
50% -100%
100% - 50%
50% - 0%
0% - 100%
100% - 0%
Mains Fail @100%

During each load level change the following parameter will be recorded using the Transient recorder.

Channel 1, 2 and 3 records the Output Voltage and Channel 4 records the Output Current on one of the phases and is used for triggering the recording.

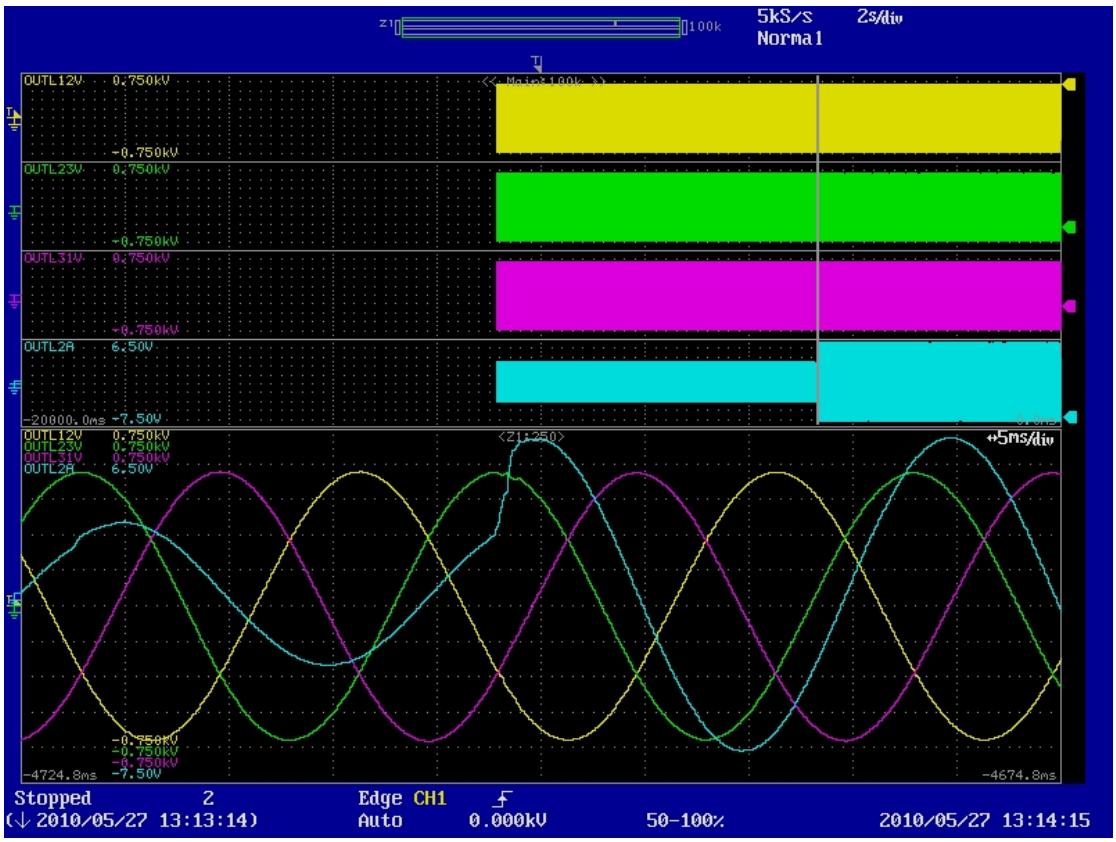
T Mobile
Site Witness Testing
UPS 2

0-50% Step Load



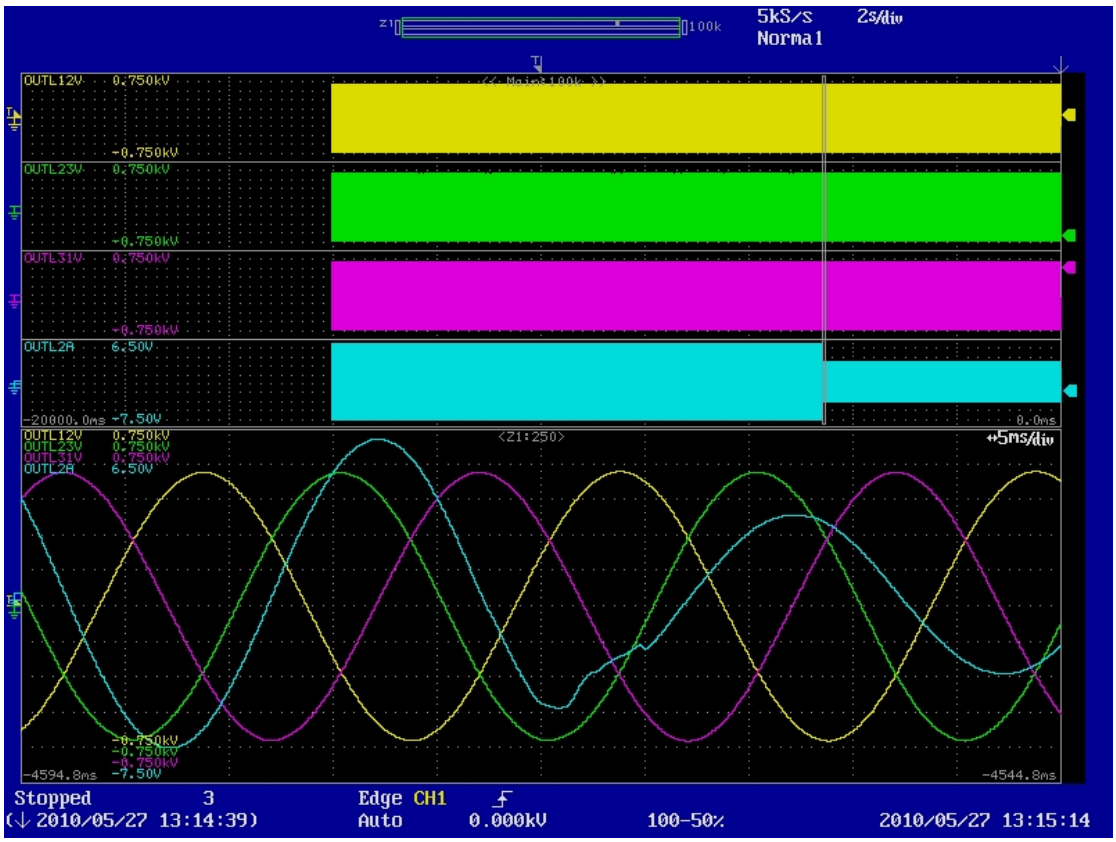
50% to 100% Step Load

T Mobile
Site Witness Testing
UPS 2



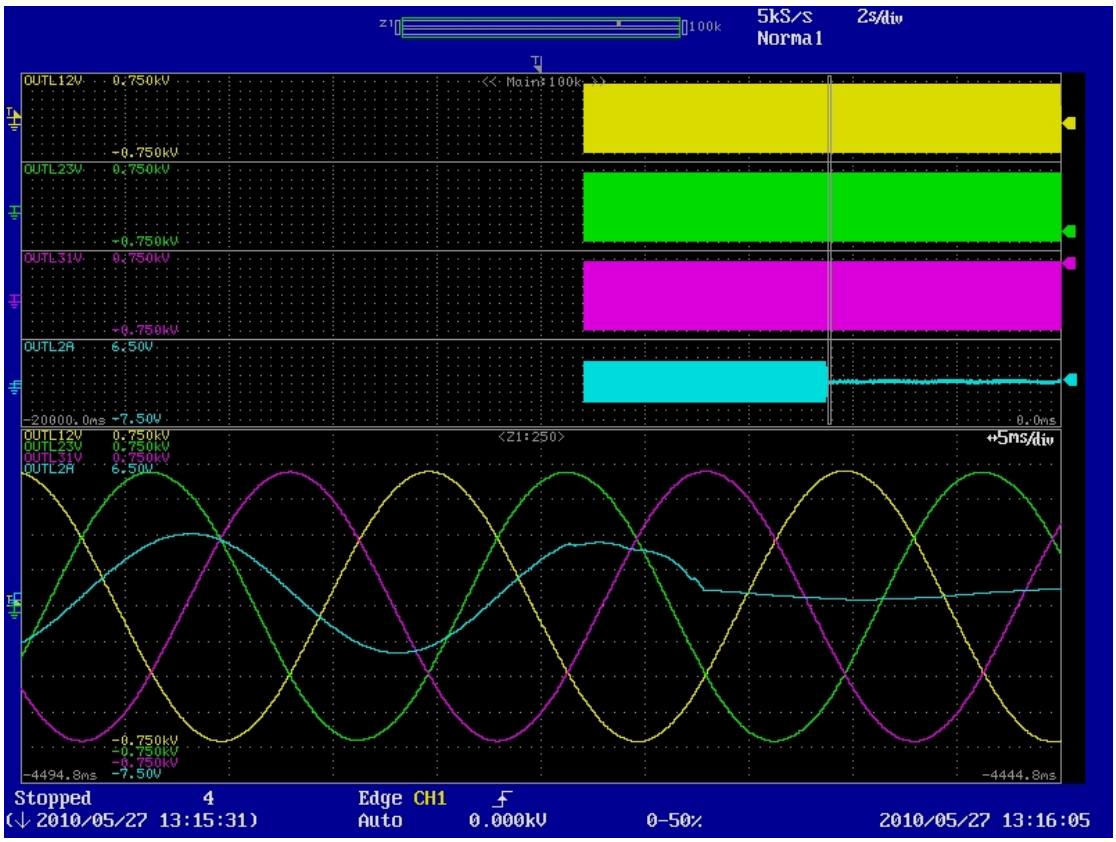
100% to 50% Step Load

T Mobile
Site Witness Testing
UPS 2



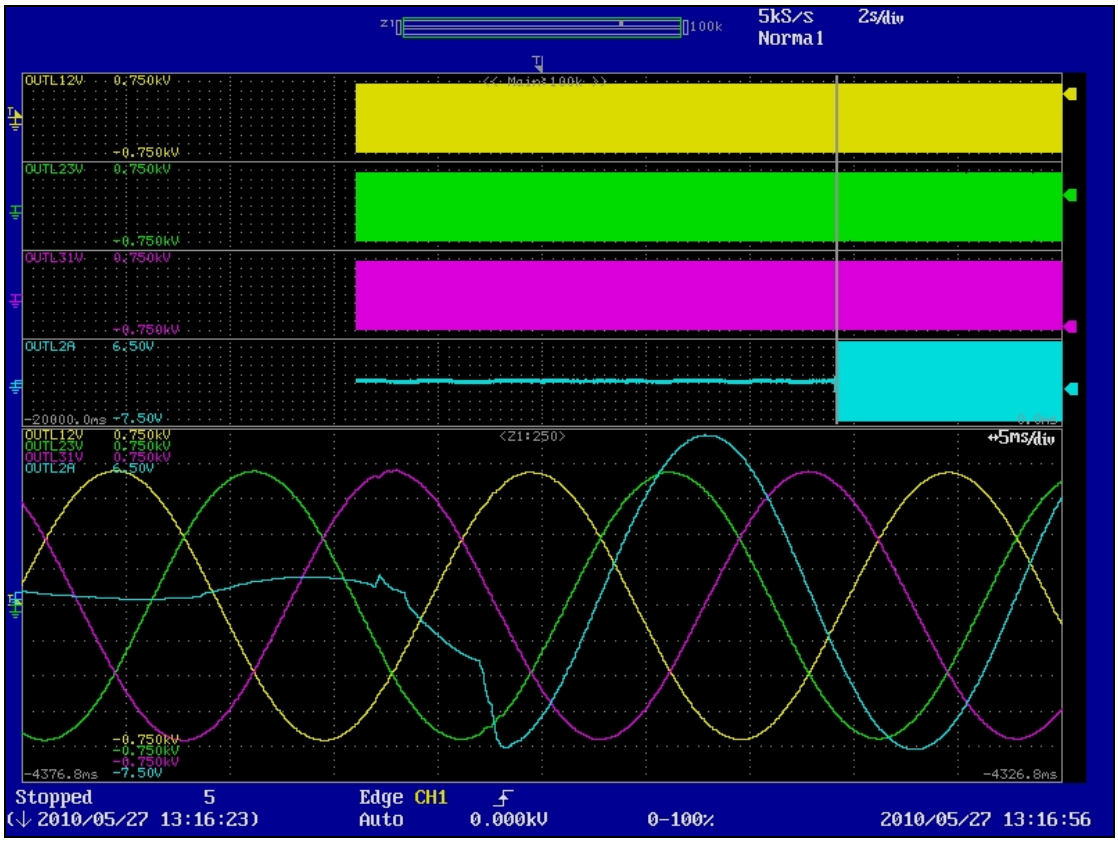
50% to 0 Step Load

T Mobile
Site Witness Testing
UPS 2



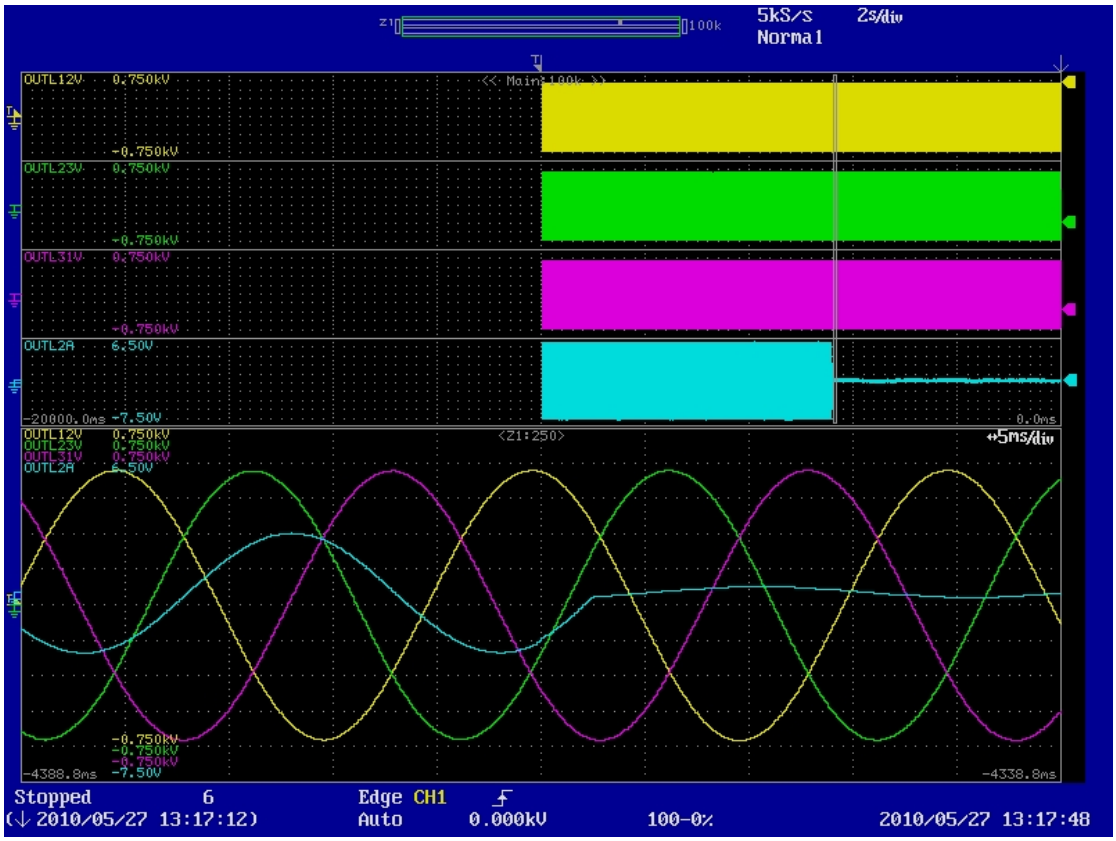
0-100% Step Load

T Mobile
Site Witness Testing
UPS 2



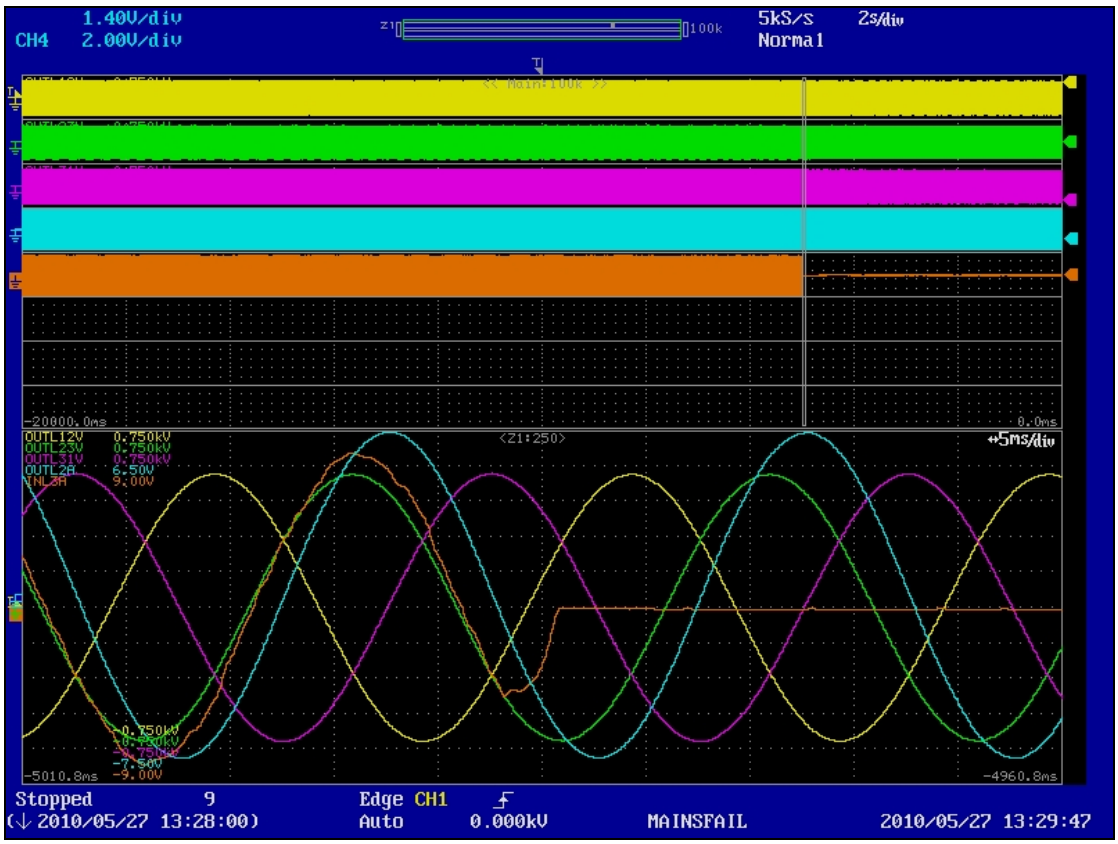
T Mobile
Site Witness Testing
UPS 2

100%-0 Step Load



T Mobile
Site Witness Testing
UPS 2

Mains Fail @ 100%



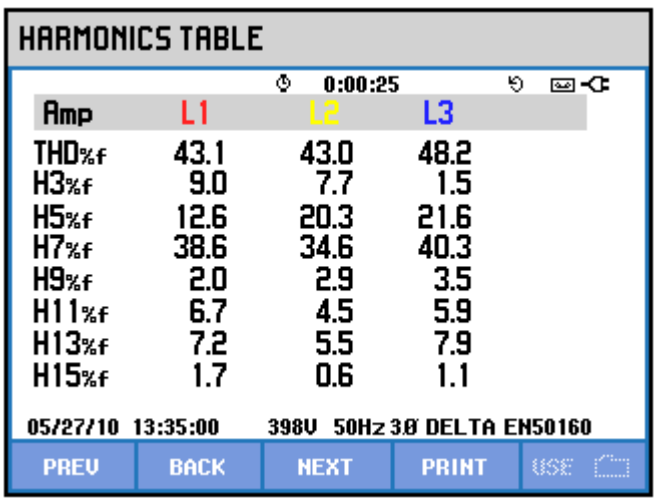
TESTS OK: YES

T Mobile
Site Witness Testing
UPS 2

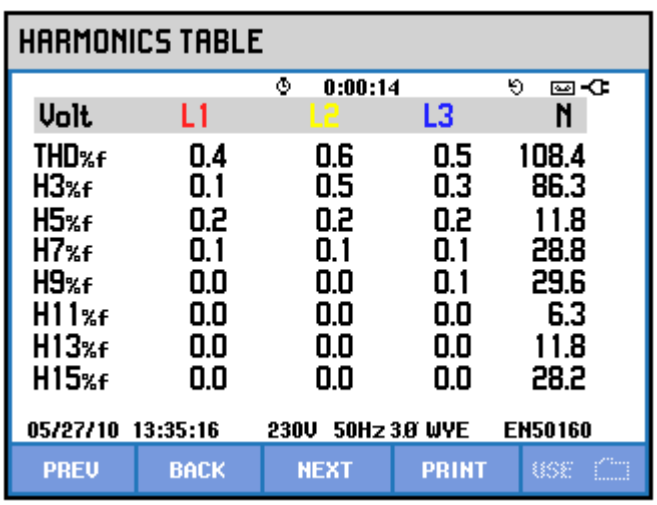
Harmonic Analysis (Record Below)

With 0%, 50% and 100% load applied to the module (@ unity pf), input current and output voltage THD will be recorded using Fluke 435 platform.

0% Load
Input Current



Output Voltage



T Mobile
Site Witness Testing
UPS 2

50% Load
Current

HARMONICS TABLE

0:00:16

Amp	L1	L2	L3
THD%f	5.2	5.0	5.2
H3%f	1.8	0.8	1.4
H5%f	1.5	1.5	1.1
H7%f	3.0	3.1	3.2
H9%f	0.4	0.9	1.2
H11%f	0.3	0.6	0.3
H13%f	2.9	2.9	3.1
H15%f	0.1	0.1	0.1

05/27/10 14:00:57 398V 50Hz 3Ø DELTA EN50160

PREV BACK NEXT PRINT USE

Voltage

HARMONICS TABLE

0:00:03

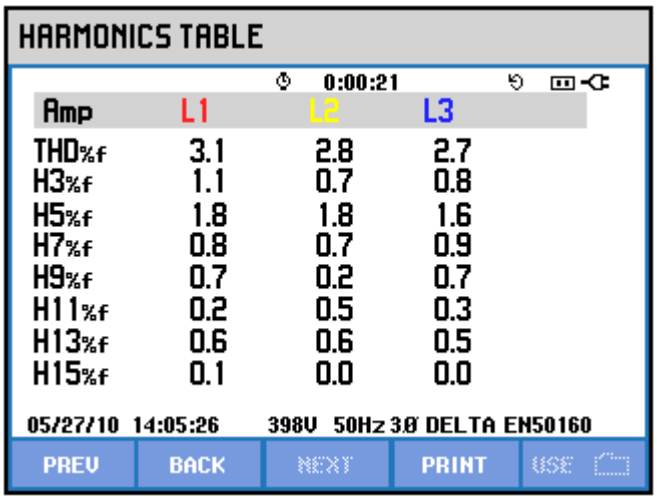
Volt	L1	L2	L3	N
THD%f	0.3	0.5	0.5	105.2
H3%f	0.2	0.4	0.4	80.4
H5%f	0.1	0.1	0.1	5.9
H7%f	0.1	0.1	0.1	24.6
H9%f	0.1	0.0	0.1	30.7
H11%f	0.0	0.1	0.0	6.2
H13%f	0.0	0.0	0.0	17.4
H15%f	0.0	0.0	0.1	28.2

05/27/10 14:02:05 230V 50Hz 3Ø WYE EN50160

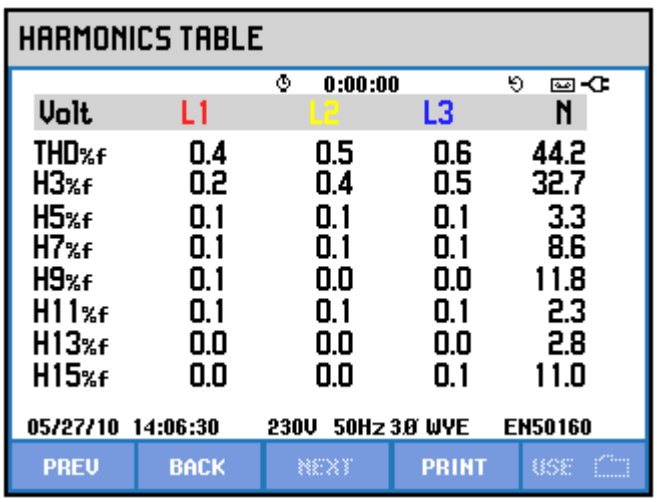
PREV BACK NEXT PRINT USE

T Mobile
Site Witness Testing
UPS 2

100% Load
Current



Voltage



TESTS OK: YES

T Mobile
Site Witness Testing
UPS 2

Transfer to and from Maintenance Bypass

With 100% load applied to the module (@ unity pf), load will be transferred to and from Maintenance Bypass. Recording equipment will be used to prove that there is no break in supply.

TESTS OK: YES